POWER

MARCH, 1944

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRY

Careful control of dichromate concentration in brine stops corrosion in refrigerating piping and equipment

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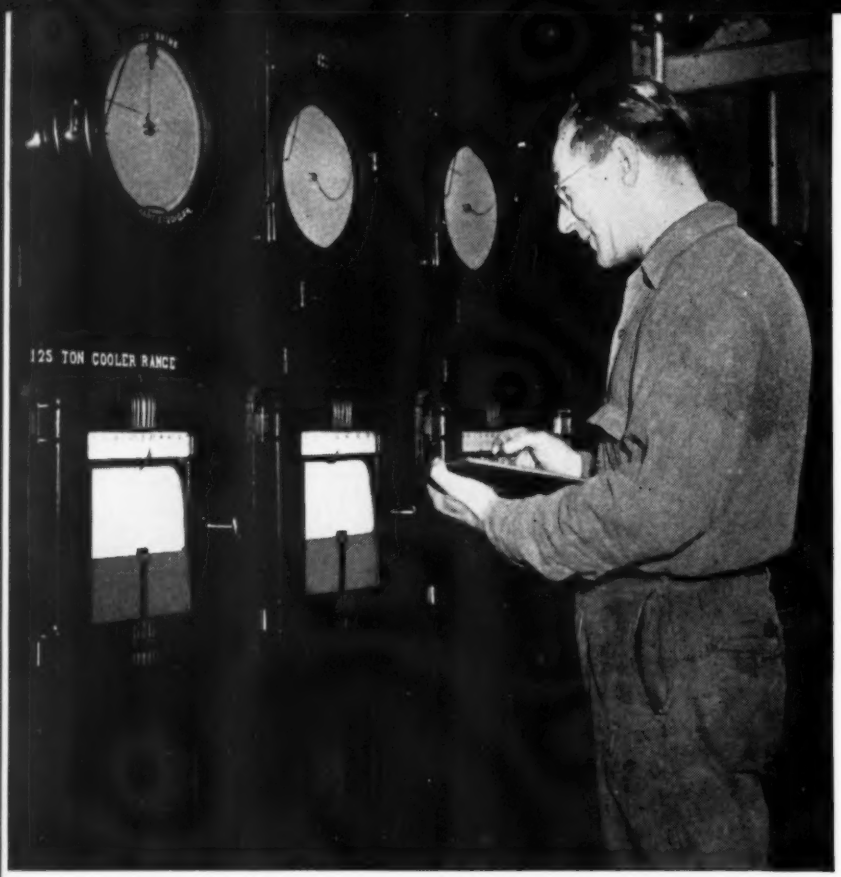
Page 59

Sewage-gas engines at Bowery Bay disposal plant, generating 1600 hp, form another step in New York's vast program that will ultimately include 25,000 hp of engines operating on sludge gas. For details of engine, blowing and pumping equipment, heat recovery and controls, turn to page 64

Refrigeration principles are easy to understand if you know what happens to the ammonia at each stage of the cycle, as it is explained in unusually clear fashion in the fundamental article beginning on page 78



Refrigeration-plant operator reads Micromax Temperature-Difference Recorder in plant of Atlantic Refining Co.

E depends on me!
A Slogan For Every American

ANOTHER STEP-UP IN REFRIGERATION EFFICIENCY

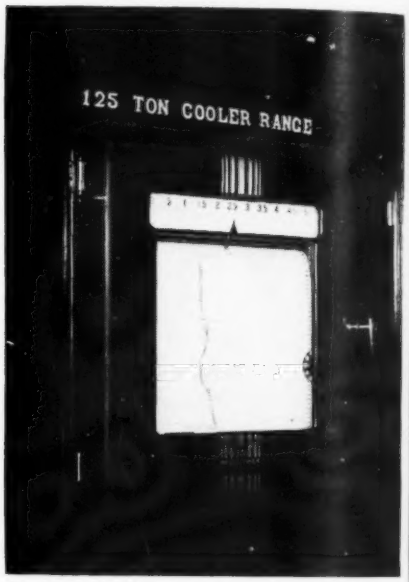
CAN FOLLOW USE OF MICROMAX SHORT-RANGE TEMPERATURE-DIFFERENCE RECORDER

Refrigeration production is of course expected to be efficient at the Atlantic Refining Co.; its engineers and operators have for years kept their eyes on the heat-balance, and have applied dozens of ideas, machines and services which increase the efficiency of refrigeration-machine operation. The regular use, by this company, of the short-range Micromax Temperature-Difference Recorders seems, therefore, to indicate that this instrument has widespread value in many plants, for closer control of commercial-refrigeration operations.

The features of this Recorder which make it particularly valuable in this service are its short range (as little as 0-5 F) and its micro-responsiveness.

The equipment employs our standard Thermohm resistance-thermometer bulbs as temperature detectors. These are especially designed to make full use of the remarkably high sensitivity which may be attained with resistors. Also, these units are matched in resistance for the low temperature and for the five-degree range—conditions which require considerable skill and experience to overcome, but which are no longer problems to the Micromax equipment.

One of these specially-matched Thermohms is in the brine inlet, and the other in the outlet of the cooler. The Micromax Recorder measures the difference between them with a micro-responsiveness so great that some of its motion may be hard to see. But the effect shows in the record; the five degrees of temperature difference are spread across a chart almost ten inches wide, so that each degree has almost two inches. This extremely detailed



Close-up of Micromax Temperature-Difference Recorder. Range is only 0-5 F; note open, easy-to-read record curve. This instrument operates directly from 115-volt line; no dry cells employed; thus its sensitivity is not impaired by voltage changes.

showing of the temperature difference on which efficiency largely depends, helps the refrigeration-machine operator to anticipate temperature changes—head them off while they're still only beginning—hold temperature with the steadiness essential to highly efficient refrigeration.

This Micromax and all other models are described in Catalog N-33C, sent on request. If you have a specific problem in refrigeration, however, we suggest that you outline it so that additional specific facts can be submitted.

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.
LEEDS & NORTHRUP
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

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TECHNOLOGY DEPT.

LAY THAT "BELT" DOWN ON LINK-BELT ANTI-FRICTION BELT CONVEYOR IDLERS

and be assured of maximum belt life, minimum power and maintenance cost, and dependable trouble-free conveyor service. Link-Belt engineers pioneered in the development of anti-friction belt conveyor idlers and have consistently improved the original, fundamental design—the grease seal, bearing adjustment, shaft mounting and the supporting stands and brackets. All with the result that today's Link-Belt designs offer the very best in belt conveyor equipment.

9451

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Toronto 8.
Offices, factory branch stores, and distributors in principal cities.

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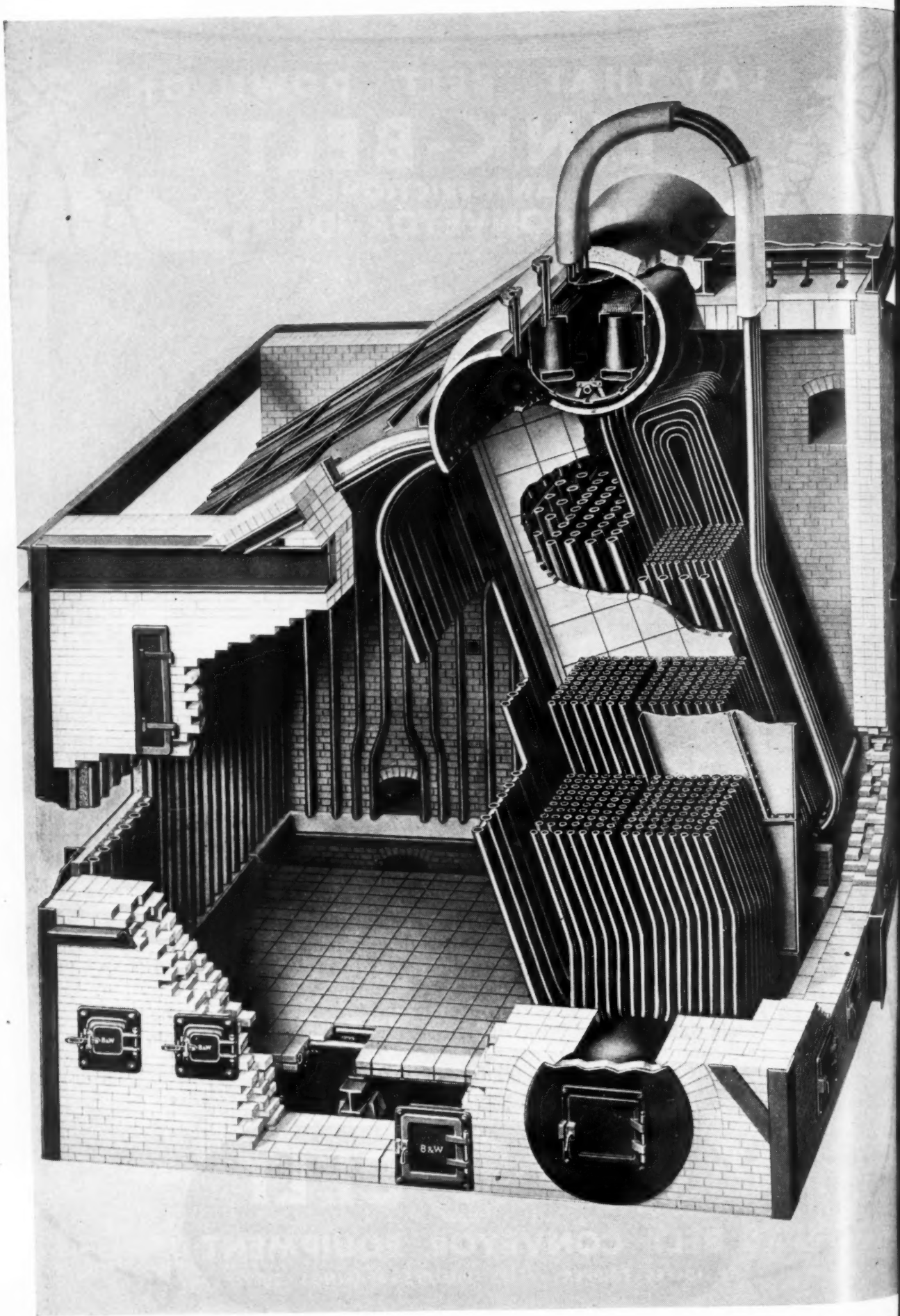
THE SYMBOL OF QUALITY — LINK-BELT COMPANY

BELT CONVEYOR EQUIPMENT

IDLERS • TRIPPERS • BELTS • PULLEYS • BEARINGS • DRIVES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THEIR DEPENDABILITY IS TWICE PROVED

In steel mills, chemical plants, refineries, ordnance plants, aircraft factories . . . wherever American industries are busy producing weapons of war, Babcock & Wilcox Integral-Furnace Boilers are supplying steam with utmost dependability and efficiency. Thoroughly tried and proved in pre-war services, these boilers are now further demonstrating their high availability for service and consistent reliability in a second set of tough assignments.

Faithful performance has been made certain in these B&W boilers by distinctive design and construction features such as:

1. Water-cooled furnace sidewalls and roof of the same durable stud-tube construction used in large central-station boilers.
2. Deep furnace, fired from one end, provides ample space for complete combustion.
3. Bare metal blocks cover and protect the tubes of the water-cooled furnace floor, provide a surface readily cleared of ash.
4. Self-draining superheater design prevents accumulation of water in the tubes from direct furnace radiation, and a stud-tube wall shields the second and third banks.
5. Tubes of the third bank, which is in the zone of coolest gases, act as downcomers, insuring rapid positive circulation at all loads.

From their additional war-time proving under unprecedented service conditions will come still better B&W Integral-Furnace Boilers to serve post-war industry.

THE BABCOCK & WILCOX CO., 85 LIBERTY STREET, NEW YORK 6, N. Y.

For additional information on B&W Integral-Furnace Boilers, send for Bulletin G-17-A.

BUY MORE WAR BONDS! ★

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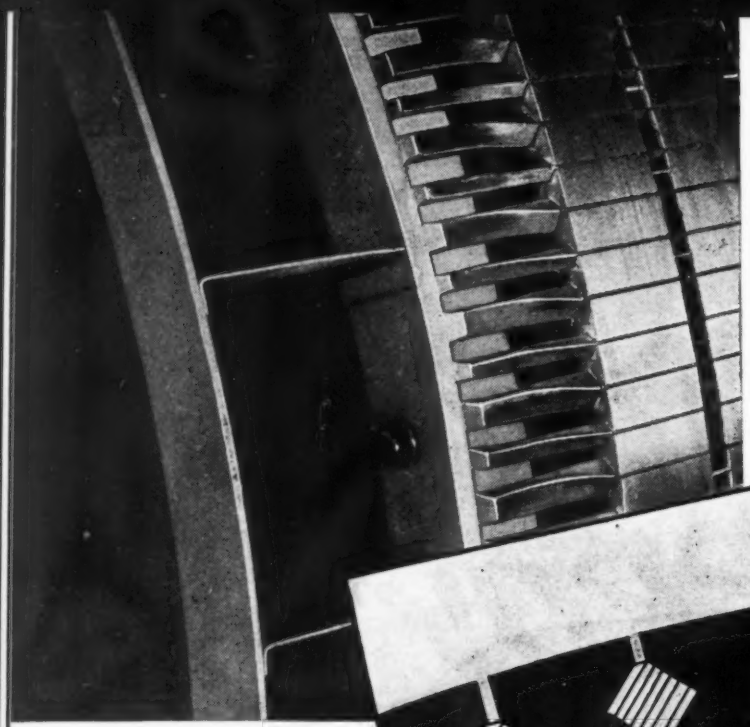
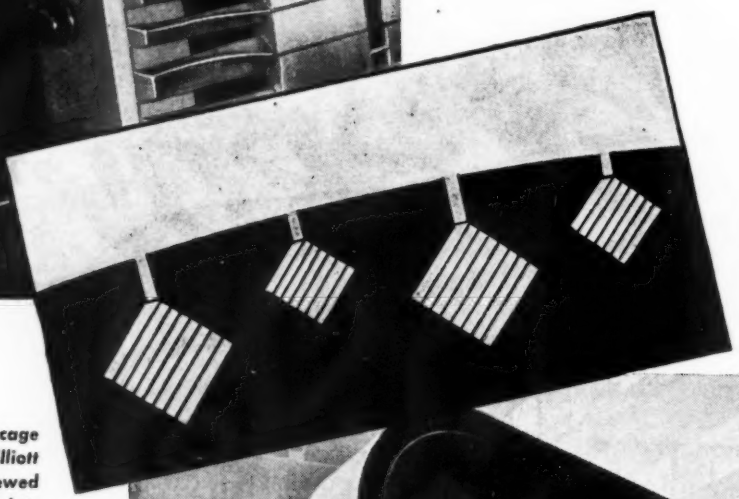
Elliot!



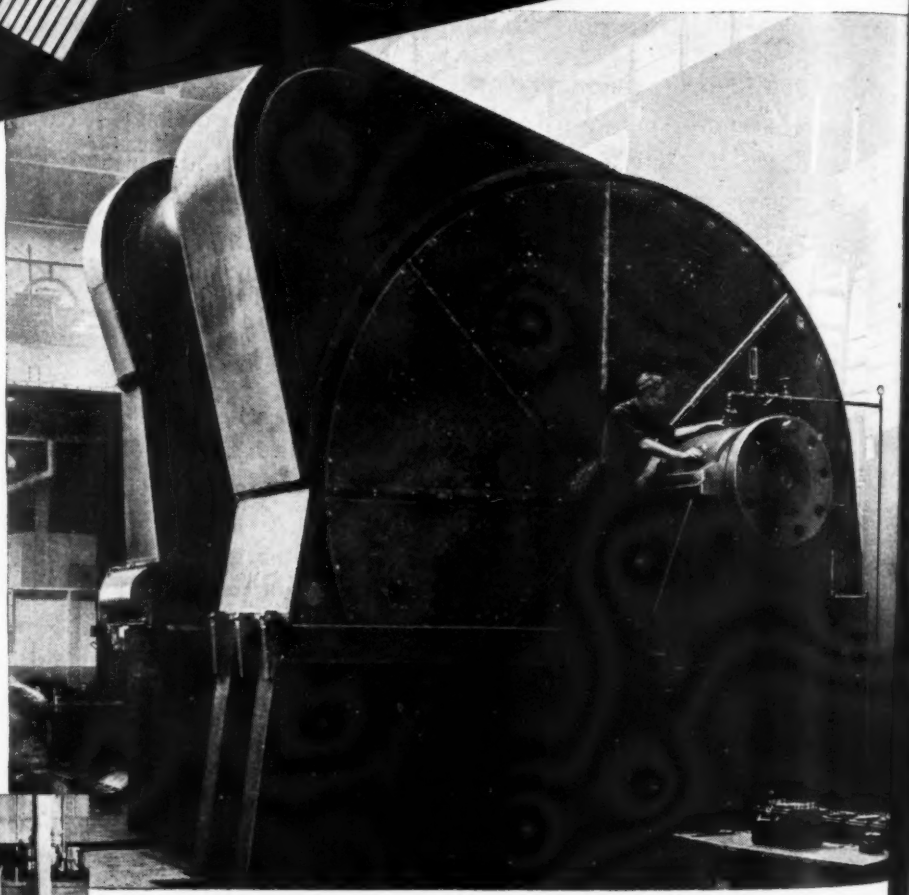


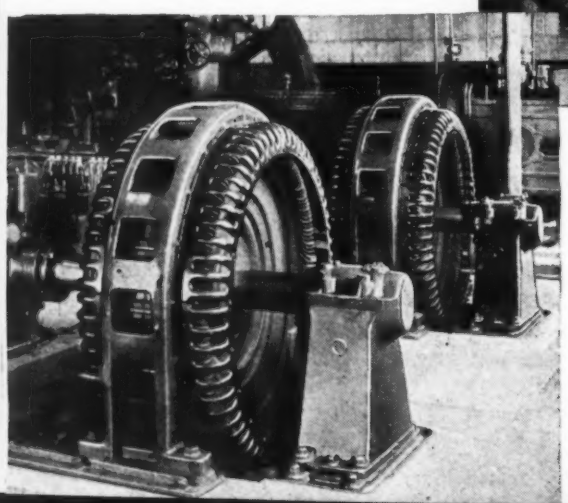
Detail of diamond cage arrangement, showing comparatively broad area, and consequent strength, of laminations.

At top: Close up of diamond cage construction as developed for Elliott squirrel-cage motors. The skewed formation of the bars assists mechanical stiffness.

At right: One of a large number of Elliott 6600-hp. synchronous motors for tanker propulsion. These motors have Elliott diamond cage winding. Photo shows motor completely covered, with its ventilating system. (In these vessels, Elliott furnishes also the main and auxiliary turbine-generators, desuperheaters, mechanical drive turbines.)

Below: Two Elliott engine-type synchronous motors driving compressors. Superintendent in this plant says these are the quietest motors he has ever seen.





ELLIOTT

engineering advances motor design

ELLIOTT DIAMOND CAGE CONSTRUCTION

- Achieves high starting torque, low starting current in A. C. motors—
- Small pole horns required reduce leakage flux in synchronous motors—
- Combines the most desirable ratio of cage resistances with the most favorable relation of cage reactances—
- Allows close nesting of bars with smallest sacrifice of strength of the iron section between bars—
- Affords means of eliminating all looseness between rotor stack and bars—
- Gives exceptional strength, and stiffness of the tip of stack—
- Combined with other structural features assures unusually quiet operation.

Ingenious engineering is characteristically Elliott. Tough problems which must be solved in new ways, are an interesting challenge to Elliott engineers, who are constantly designing special equipment for the individual job. Through this activity Elliott engineers have amassed facts and data of immense value, and have gained the habit of original thought which is an essential of all pioneering in any phase of human endeavor.

A case in point is the development by Elliott engineers of "diamond-cage" construction in squirrel-cage motor design. On the sound basis of overall results and long-term performance, we believe this construction is superior among the many efforts of motor designers to meet the requirements in this problem.

Full details of this development, including graphs of comparative tests, and data on the motors of which it is a part, may be had at request.

ELLIOTT COMPANY

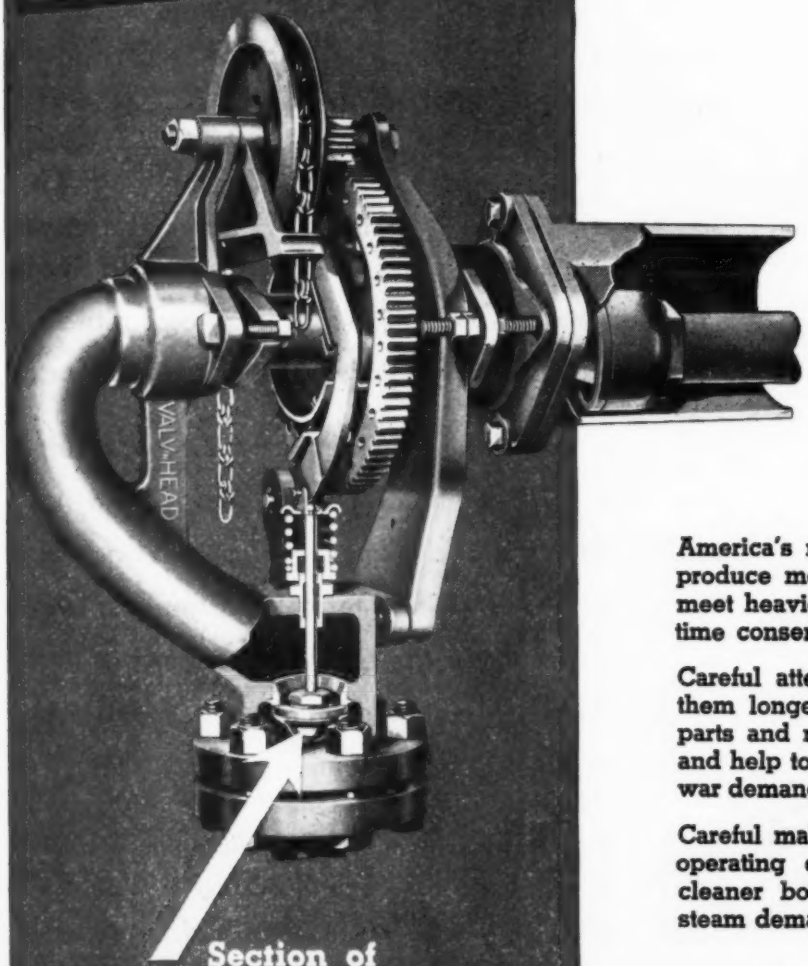
Electric Power Department, **RIDGWAY, PA.**

DISTRICT OFFICES IN PRINCIPAL CITIES

L-749

builds fine motors

Get LONGER AND BETTER SERVICE FROM THE SOOT BLOWERS YOU HAVE



Section of
G9B SOOT BLOWER
Showing Poppet Valve

Care of

VALVES AND PACKING

SAVES STEAM

★

ASSURES EFFECTIVE BLOWING

★

America's march to victory demands that we all produce more—use less. You are called upon to meet heavier requirements for steam, at the same time conserving materials in every way possible.

Careful attention to your soot blowers will give them longer useful life—will conserve on repair parts and new blowers. It is economy for you—and help to us. We are called upon to meet heavy war demands, too.

Careful maintenance also keeps blowers in good operating condition at all times. The resulting cleaner boilers makes it easier to meet heavy steam demands.

Soot Blower Valves

All valve parts of Diamond G9B Soot Blowers are made of Monel metal or stainless steel. Under normal conditions they require very little attention for a long time. Oil should never be used on valve stems as it may form a gummy deposit

which may cause them to stick. In case a stem sticks, remove and clean it with emery cloth.

Should the valve need regrinding, remove gooseneck flange bolts, then remove cap screws which hold the bottom of the bracket to the gooseneck. Then remove the nut on the inner end of the sheave wheel shaft, which will permit drawing the gooseneck off the swivel tube without disturbing the packing. Take the gooseneck to a bench and regrind or replace the valve in the usual manner. Both valve disc and valve seat are renewable.

The valve may be reground without removing the head from the boiler. Remove the gooseneck flange bolts and the nuts on the end of the bracket stud. In this way, the entire unit may be pulled out and the gooseneck may be turned to a convenient position for regrinding the valve.

Soot Blower Packing

The G9B Soot Blower is packed around the swivel tube where it enters the gooseneck and also around the valve stem.

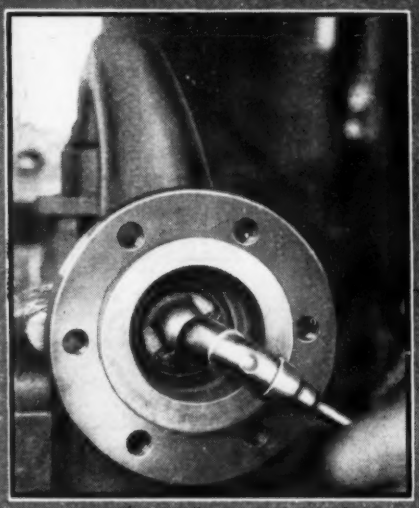
Special grade packing, made up in split rings of the correct size, is kept in stock at our factory.

If leaks develop which cannot be stopped by pulling up on the gland, add one or two rings of this special packing.

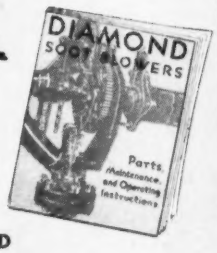
If it is necessary to repack the swivel tube gland, remove the gland bolts and pull out the gland far enough to allow insertion of new packing. Replace bolts, tighten as far as they will go. Remove gland again, insert an additional packing ring if possible and then back off the gland bolt nuts one-quarter to one-half turn so the packing will not bind the swivel tube.

To add or renew valve stem packing, remove the valve spring and unscrew the valve stem packing nut. The packing nut can then be filled with packing and replaced. Special tongs are available for removal of the valve spring.

METHOD OF GRINDING
G9B SOOT BLOWER VALVE



Write
For This
Booklet
on Care of
DIAMOND
SOOT BLOWERS



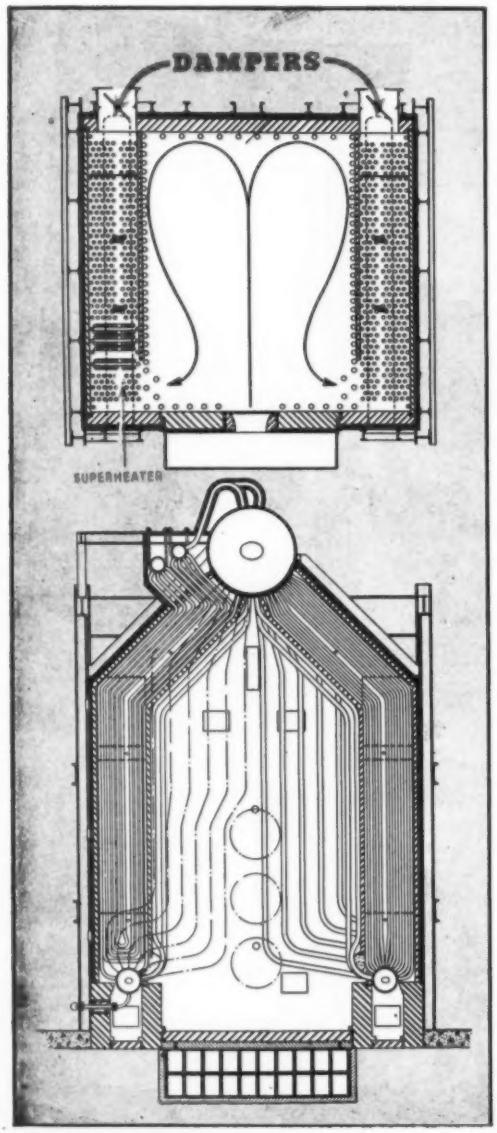
DIAMOND POWER
SPECIALTY CORP.
DETROIT, MICHIGAN
DIAMOND SPECIALTY LIMITED · Windsor, Ont.

THROW YOUR
INTO
THE FIGHT

Blazing THE

SUPERHEAT CONTROL

in "S-A" Boilers



• Wide range superheat control in "S-A" type boilers is accomplished by placing all superheating surface in one of the twin tube banks. Dampers, placed in the gas outlets, control the proportion of gas flow through this bank to give constant superheat under varying load conditions. Note that the dampers are placed in a relatively cool temperature zone.

Foster Wheeler is a Three-Star winner under the U. S. Navy Board of Awards for production.

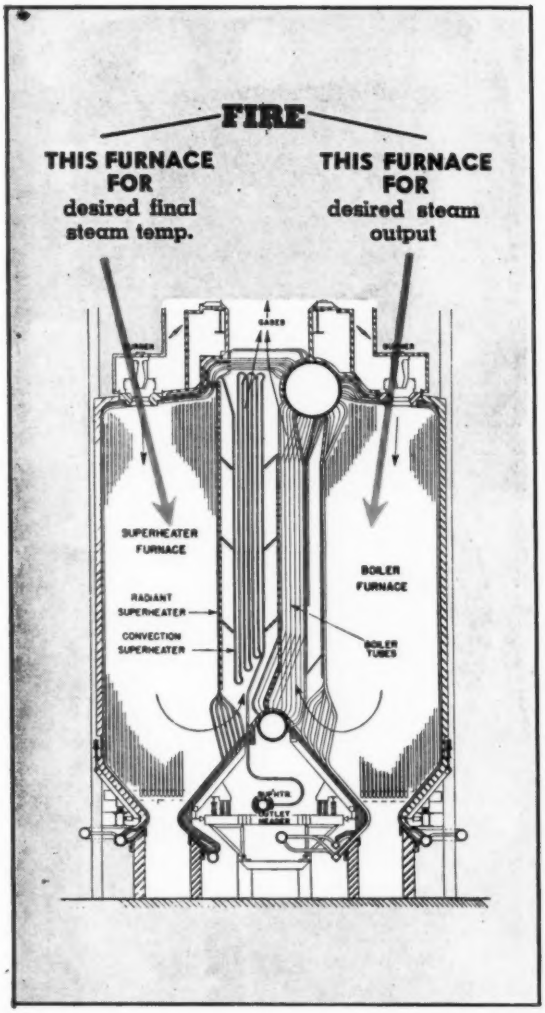
FW FOSTER

ENGINEERING TRAIL

SUPERHEAT CONTROL
in Twin Furnaces

• Final steam temperature is determined by rate at which superheater furnace is fired and, therefore, steam temperature can be kept constant or varied at will independent of the quantity of steam produced, rapidity and width of load swings, changes in feedwater temperature or influence of other factors.

The use of the combination radiant and convection superheater gives an additional temperature control which simplifies operation, i.e., with increasing load the superheat increases on convection section and decreases on radiant section. By proper proportioning of the radiant and convection sections, superheat can be held virtually constant from 40% to 100% normal load. Below 40% of load, superheat can still be kept constant by firing superheater furnace slightly harder than boiler furnace.



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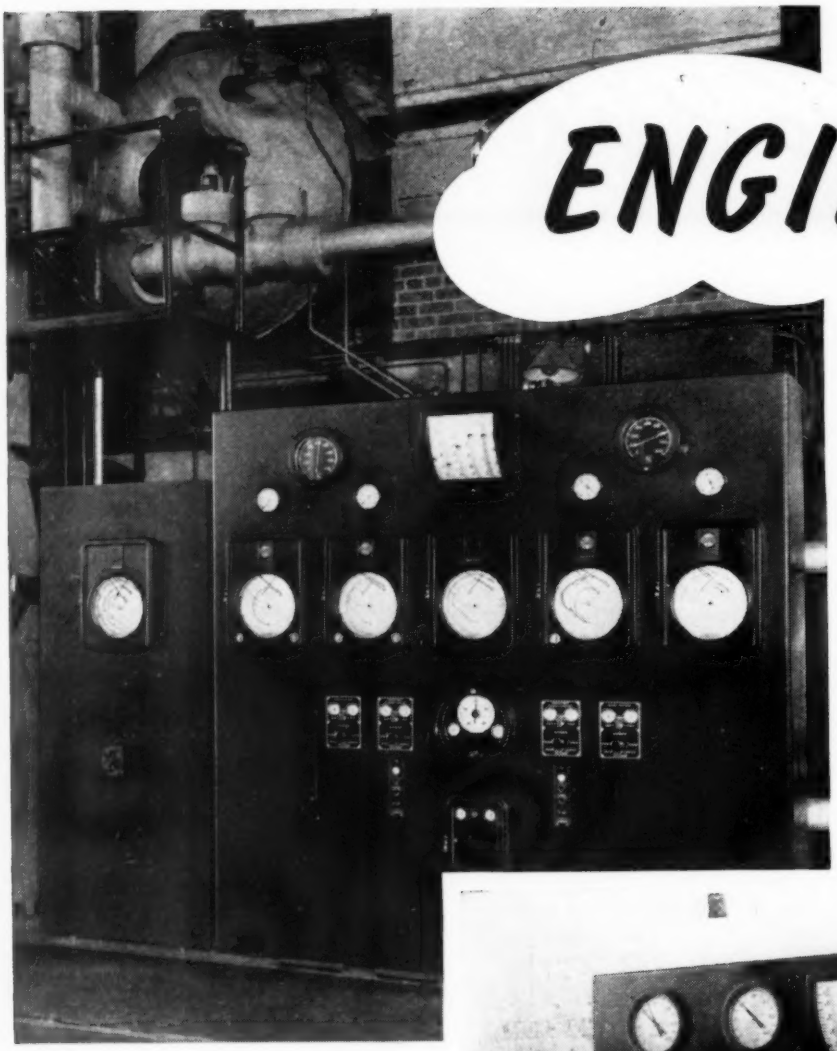
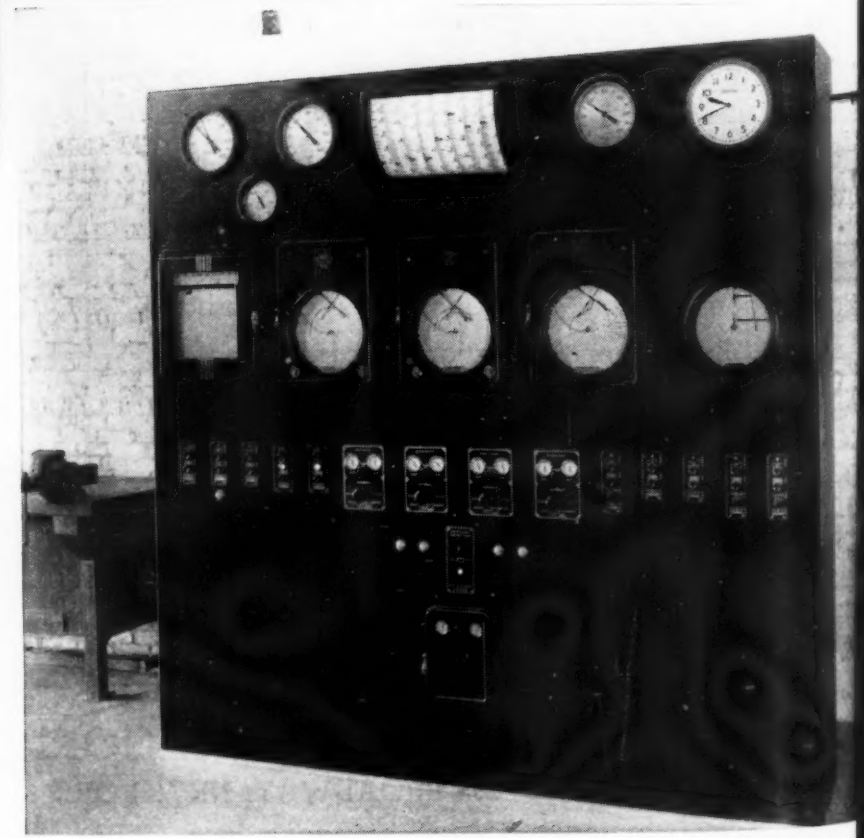


ENGINEERED

★ ★

This Bailey Boiler Control System for Combustion and Feed Water is engineered to a 450 psi, 120,000 lb. per hr. capacity natural gas fired boiler to secure optimum results in everyday operation.

A 200 psi, 100,000 lb. per hr. capacity stoker fired boiler is operated at a continuous efficiency of 87% by this Bailey Combustion and Feed Water Control System.



BAILEY METERS

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERH

INSTRUMENTATION Conserves Fuel

★ Maximum fuel conservation is obtained when a boiler plant is operated so that the sum of all controllable heat losses is a minimum. This condition is usually reached when excess air has been reduced to the point where losses from unburned fuel and CO cancel any advantage gained by further reduction of excess air.

Often the amount by which excess air may be reduced is limited by other factors such as refractory deterioration, smoke, and superheat control.

The key to fuel conservation is a correct determination of the optimum excess air value at which each boiler unit should be operated. This value is determined by combustion tests made under actual operating conditions. Once determined, the optimum value is used in setting the Bailey Boiler Meter and from then on fuel economy is simply a matter of vigilance on the part of manual operators or the automatic control system.

This approach makes it possible to conform with war conservation measures through increased efficiency rather than at the sacrifice of product output. It is a procedure by which the experience gained in the most efficient power plants may be put to use in power plants everywhere. It is engineered instrumentation based on the particular requirements of each boiler unit.

To quickly and efficiently serve Power Engineers in this all important phase of instrumentation, Bailey Engineers are located in over 30 industrial areas throughout the United States and Canada. The Bailey Engineer in your community has a wide background of combustion engineering know-how at his command. It covers combustion tests on thousands of boiler installations including a wide range of fuels, furnaces and fuel burning equipment. He is in a position to help you not only with the problem of fuel conservation but also with other problems such as safety, steaming capacity, conservation of man power and continuity of power service.

BAILEY METER COMPANY
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Bailey Meter Company Limited, Montreal, Canada

G-20

e Complete Combustion Control System

ROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

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MOVING 23 cu. yards at a time is a job that takes extra heavy equipment and plenty of Diesel power.

Regardless of size, Diesels perform better, lubricated with Texaco.

Texaco Algol or *Ursa Oils* for Diesels increase life of rings, pistons, liners and bearings, keep rings free in their grooves, valves active, ports clear, assuring piston seal that means full power and maximum fuel economy. In fact—

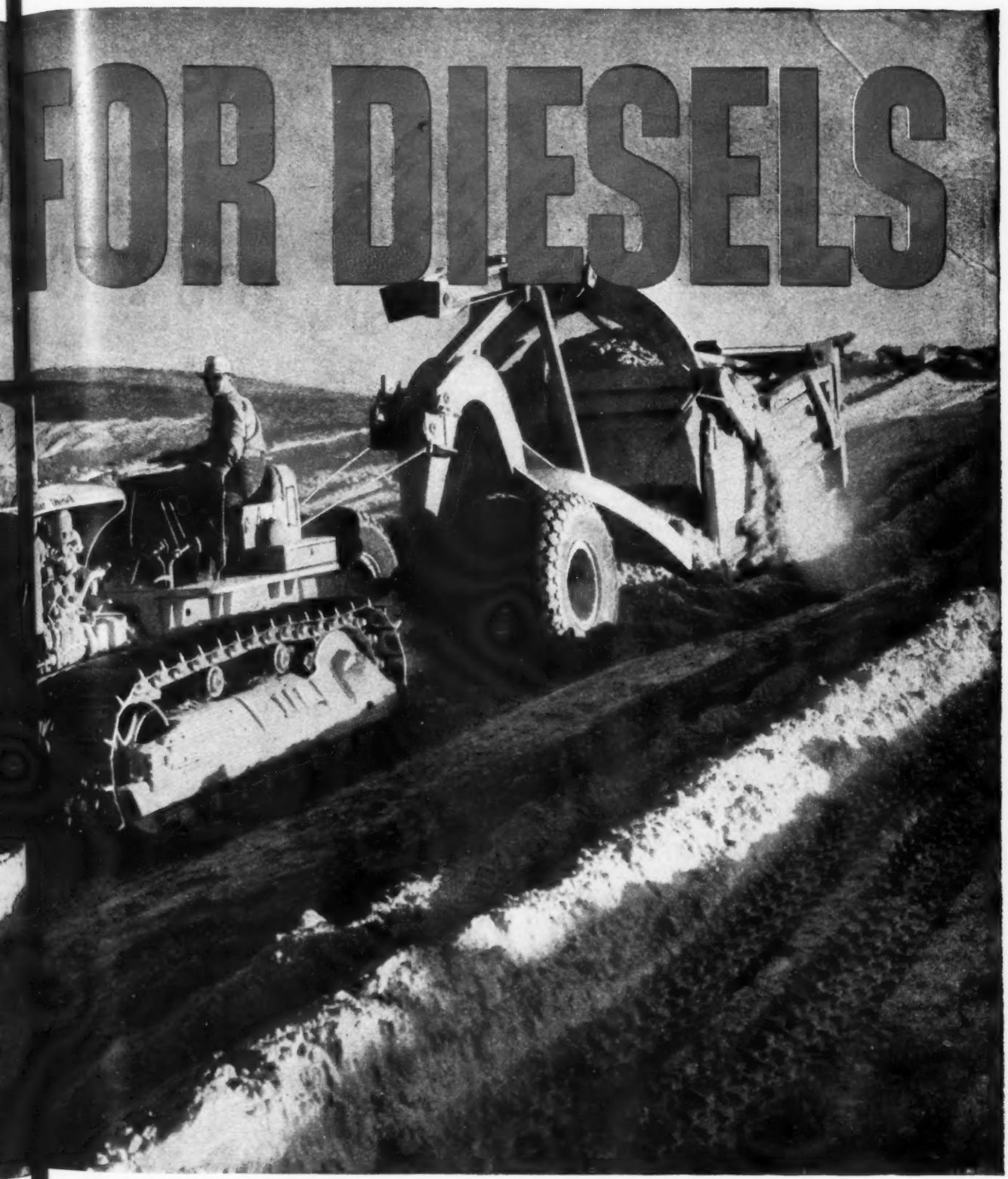
More stationary Diesel hp. in the U.S. is lubricated with Texaco than with any other brand.

Texaco Lubrication Engineering Service is available to you through more than 2300 Texaco distributing points in the 48 States. The Texas Company, 135 East 42nd Street, New York 17, N.Y.

TEXACO

TEXACO

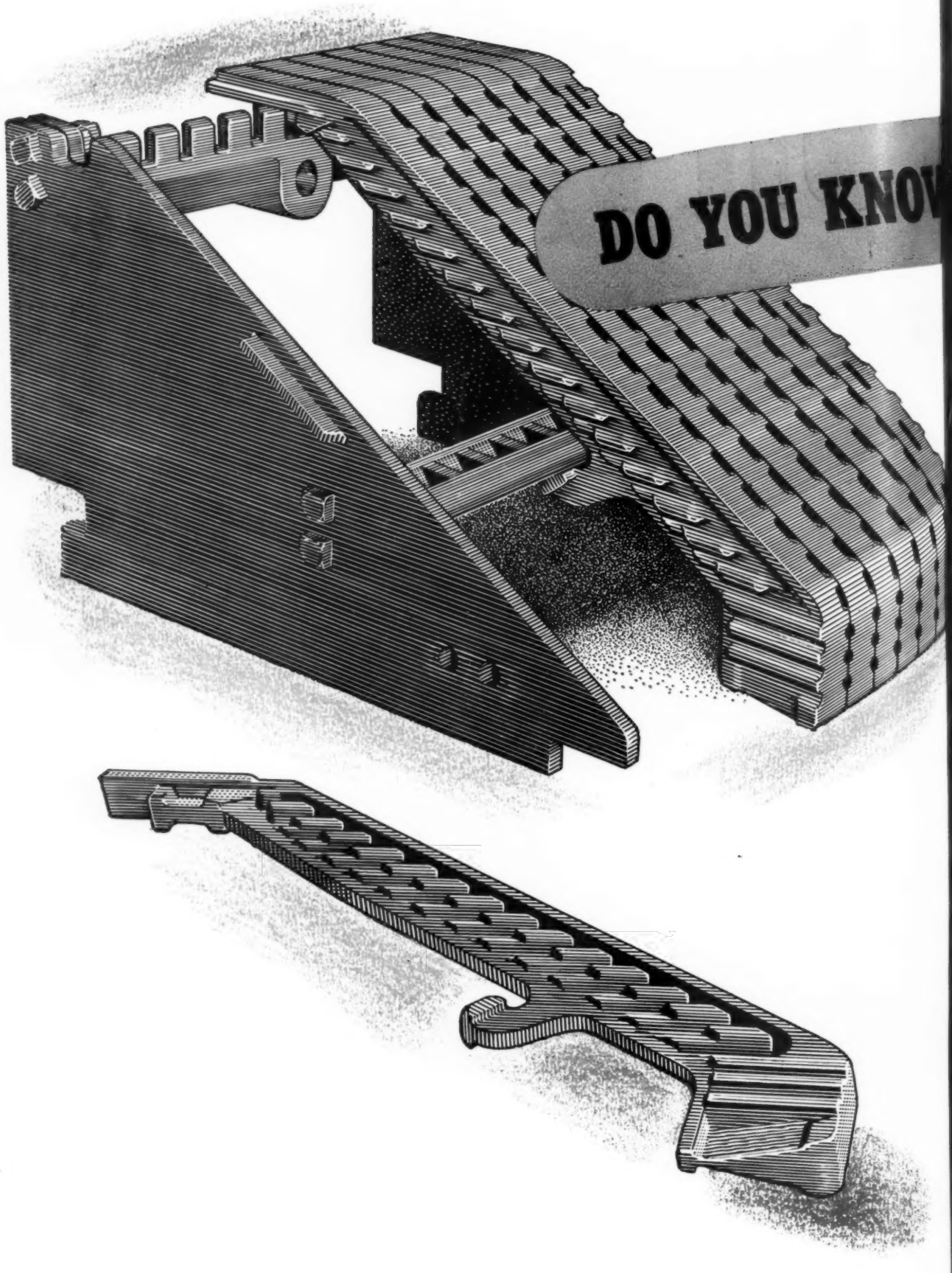
TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—C



ubricants and Fuels

FOR ALL DIESEL ENGINES

LP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY


DO YOU KNOW

THE IMPORTANT BENEFITS of these

EXTENSION GRATE BARS?

A PROPERLY designed extension grate is essential in a stoker if the fixed carbon is to be burned out of the ash and movement of the ash is to be controlled.

Taylor Stoker's Narrow Hi-Hook Extension Grate Bars, the result of many years development, burn out most of the combustible in the ash, effectively move the ash, and at the same time cut maintenance and replacement costs.

There are six sound reasons for increased efficiency at lowered cost:

- Improved air distribution insures the burning out of fixed carbon.
- Improved locking device—damage at lower end does not release bar.
- Improved ash and clinker movement.
- Easily renewable without the use of special tools.
- Longer life of grate bars.
- Less replacement expense.

Narrow Hi-Hook Extension Grate Bars are responsible, along with many other features, for the efficient operation of Taylor Stokers in generating steam at low cost.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. RELIABILITY—the ability to operate with minimum outage and minimum standby equipment.

2. CAPACITY—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.

3. MAINTENANCE—the ability to operate continuously with minimum repair costs.

4. FLEXIBILITY—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.

5. EFFICIENCY—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.

6. OPERATION—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.

7. ADAPTABILITY—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.

8. FUEL FLEXIBILITY—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.

9. REFUSE DISPOSAL—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.

10. STACK DISCHARGE—the practical elimination of "smoke nuisance" without special equipment.

11. SPACE REQUIREMENTS—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.

12. OBSOLESCENCE—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

A-E-CO TAYLOR STOKERS • LO-HED HOISTS
HELE-SHAW FLUID POWER • MARINE DECK AUXILIARIES

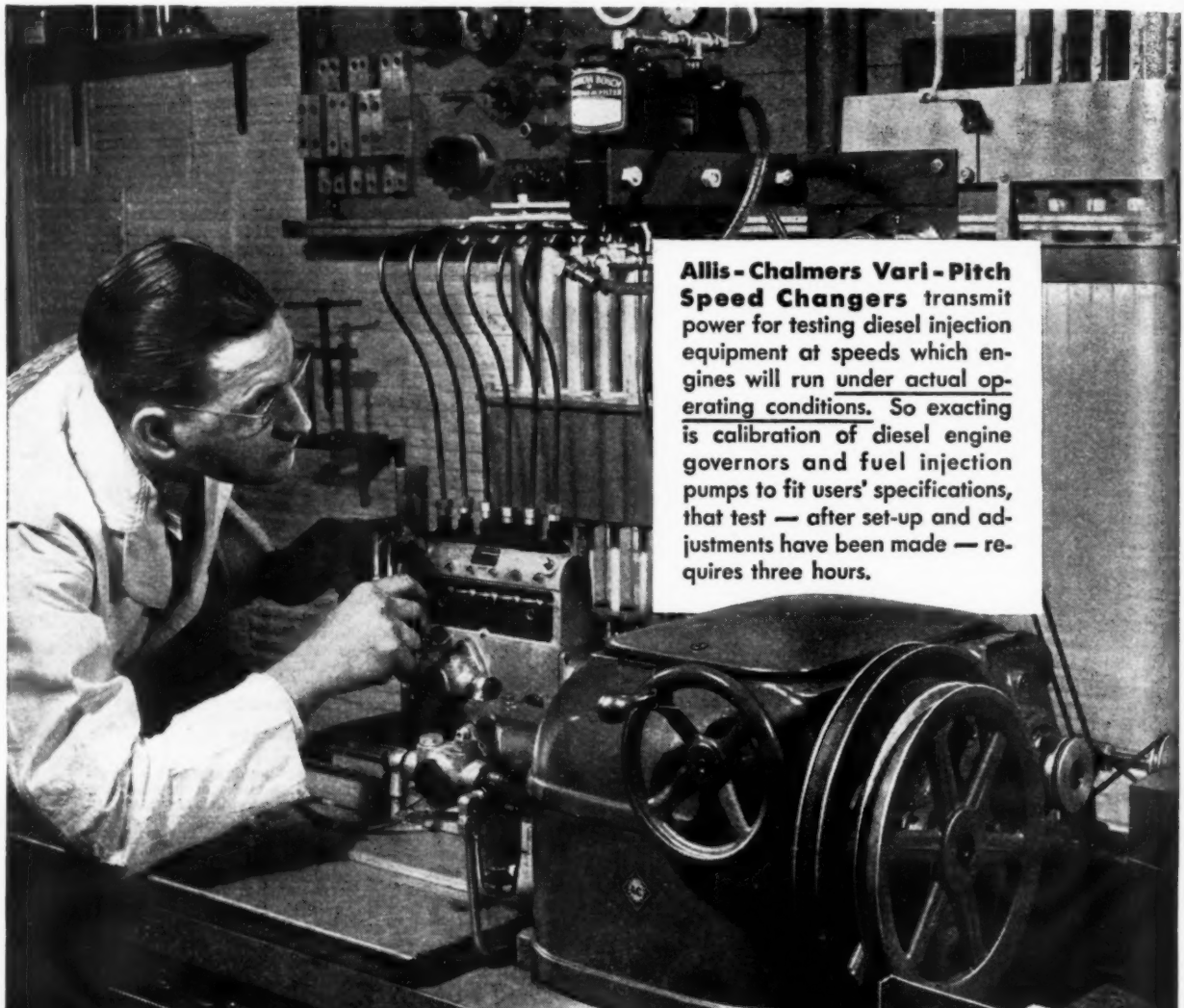
A-E-CO TAYLOR STOKER

AE CO 75

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25 • PENNSYLVANIA

PRODUCT OF THE MONTH



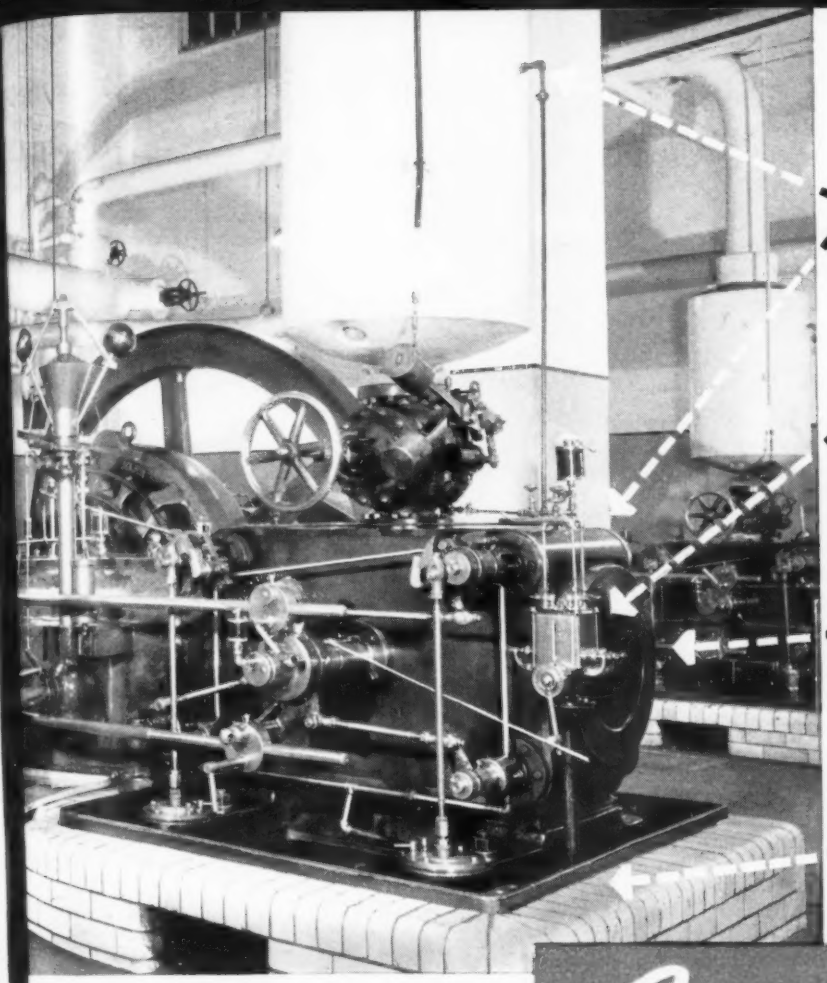
Allis-Chalmers Vari-Pitch Speed Changers transmit power for testing diesel injection equipment at speeds which engines will run under actual operating conditions. So exacting is calibration of diesel engine governors and fuel injection pumps to fit users' specifications, that test — after set-up and adjustments have been made — requires three hours.

MILWAUKEE, WIS.—Allis-Chalmers Vari-Pitch Speed Changers supply unwavering power to precision machines calibrating diesel engine governors and fuel injection pumps . . . where clearances of 39/1,000,000 of an inch can be measured only by oil leak-off, not by micrometer. Send for B6013.

A 1704

WE WORK FOR VICTORY — WE PLAN FOR PEACE

ALLIS-CHALMERS · MILWAUKEE · WISCONSIN



1. LESS DEPOSITS

2. LOWER OIL CONSUMPTION

3. BETTER LUBRICATION

4. CLEANER EXHAUST STEAM

5. ALL-PURPOSE CYLINDER OIL

5 operating advantages with *New* STANOCYL Steam Cylinder Oil

1. Less deposit formation. New Stanocyl protects engines against the formation of deposits. It contains a combination detergent and oxidation inhibitor in addition to special steam cylinder oil compounding. This inhibitor reduces oxidation of the oil at high temperatures—one frequent cause of deposit formation. The detergent additive helps keep deposits—either oxidized oil or foreign matter—from settling out at points of low steam velocity. Thus, the potential deposit-formers are carried through the engine and are easily removed from the exhaust steam.

2. Lower oil consumption. New Stanocyl atomizes readily even in the heaviest grades. This means that a heavier grade than would normally be used can be applied to take advantage of lower oil feeds, and still give adequate lubrication.

3. Better lubrication. New Stanocyl has unusual wetting ability. It adheres to cylinder walls and replaces any water present. It also resists the washing action of water such as is encountered in unusually wet steam. These factors, plus better atomization, contribute to more effective lubrication.

4. Cleaner exhaust steam. New Stanocyl separates readily from exhaust steam. Where steam is used for processing or heating, proper separators adequately serviced will keep the steam free from oil carry-over.

5. An all-purpose cylinder oil. New Stanocyl is made in three grades. Two grades, W and SH, are available for special operating conditions. Stanocyl D is an all-purpose steam cylinder oil. This one oil will handle the cylinder lubrication requirements of a plant having a variety of engines. It will lubricate both high and low pressure cylinders of compound engines. Stanocyls have given excellent satisfaction at steam pressures ranging from 100 pounds saturated steam to 250 pounds with 100° F. superheat.

A Standard Lubrication Engineer will be glad to work with you in applying Stanocyl D to reduce troublesome operating problems. Call the nearest Standard Oil Company (Indiana) office, or write 910 S. Michigan Ave., Chicago 5, Illinois, for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

Oil is Ammunition . . . Use it Wisely

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

•LUBRICATION ENGINEERING•••LUBRICATION ENGINEERING•••LUBRICATION ENGINEERING•••LUBRICA

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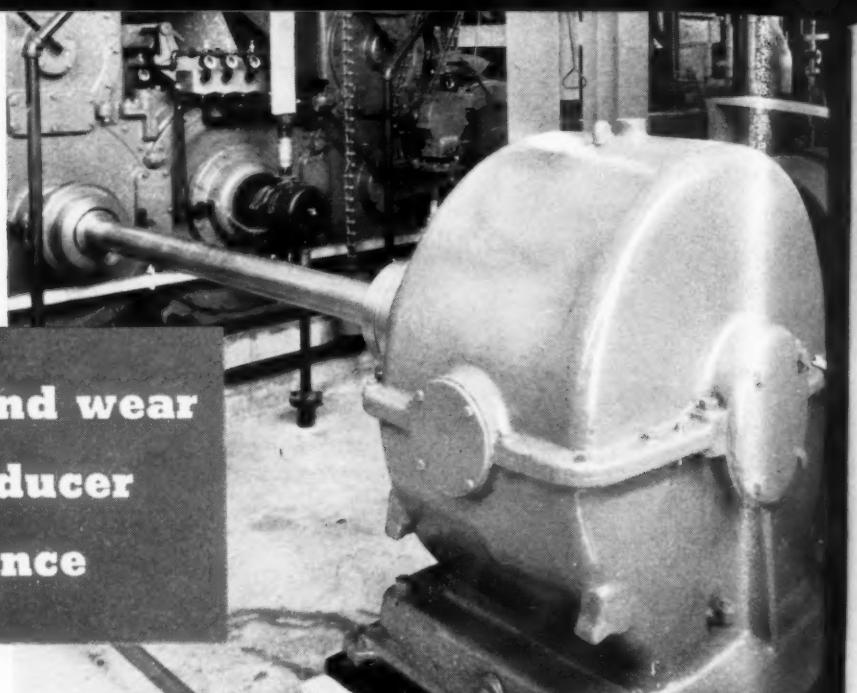


Avoid work and wear in speed reducer maintenance

Barring mechanical faults in equipment, the right oil will help avoid numerous difficulties which haunt overworked speed reducers or bath-oiled gears—particularly deposit, emulsion, foaming and starting troubles. If you find it necessary to clean gear cases or change oil in them frequently, or if you find too much gear wear, it should pay you to review your oil requirements.

Look into the qualities of Stanoil. Many operators have found it ideal for these services. Why it has proved so effective is discussed in the "trouble" and "cure" columns at the right.

Let a Standard Lubrication Engineer help you test the right grade of Stanoil. Call the nearest Standard Oil Company (Indiana) office, or write 910 S. Michigan Ave., Chicago 5, Ill., for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

Oil is Ammunition . . . Use it Wisely

★ STANOIL ★

Causes of oil trouble in speed reducers

Deposits. Under heat and agitation in the presence of oxygen, some oils oxidize—that is, certain unstable hydrocarbons undergo a chemical change. Some form asphaltenes which settle out of the oil. Others form acidic substances which attack certain metals, and form metallic soaps. Both cause deposits which may clog oil passages and lead to excessive wear on bearings and gears.

Emulsions and foaming. Acidity also reduces the demulsibility of oil. Any moisture that enters gear cases through leakage or condensation, will mix with the oil and form an emulsion—particularly if dirt or foreign matter is present. This reduces the oil's lubricating quality, causes foaming and may also cause clogging of oil lines.

Hard starting. This trouble occurs most frequently where speed reducers must operate under widely varying temperatures. These units may be warm enough when running to require a fairly heavy oil. But the same oil, at cold starting temperatures, is usually stiff—it boosts power demands. Units may refuse to start at all until heated. When lighter oils are used, starting is easy, but as the temperature rises, most light oils thin out excessively, and cannot give proper protection under load.

How Stanoil helps avoid them

High stability. The problem in producing an oil that reduces deposits is to remove the unstable hydrocarbons—those that unite readily with oxygen. This has been accomplished in Stanoil by a unique refining process. Stanoil has high stability against oxidation. Frequent oil changes made necessary because of high oil acidity, or gear case cleaning to remove deposits, are materially reduced with Stanoil.

Good demulsibility. The high oxidation stability of Stanoil gives it great resistance to acidity formation—one reason why Stanoil does not emulsify readily with water even in the presence of dirt. Also, Stanoil separates easily from water and may be used for long periods without emulsion or foaming trouble.

High viscosity index and low pour test. The combination of these qualities is needed to eliminate starting troubles. High V. I. prevents excessive thickening at low temperatures, and excessive thinning out at high temperatures. Low pour point prevents oil flow stoppage caused by paraffin wax formation. All grades of Stanoil have this combination of qualities in very high degree. That is why the same grade of Stanoil helps cold speed reducers to start more easily, yet gives perfect lubrication under high operating temperatures.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

A GOOD MAN TO KNOW

—when you're buying synthetic rubber industrial products

Now with the mandatory conversion of industrial rubber products to synthetics, you need expert counsel more than ever in selecting the correct grades and constructions for your particular service.

That is why more and more operating men are guided by the recommendations of the G.T.M. — Goodyear Technical Man. An expert in industrial rubber, he is backed by Goodyear's twenty years' experience in developing synthetics and by the authority of the world's finest rubber research laboratory.

Long before the war, Goodyear was building many industrial products from synthetic rubber, based on knowledge that goes back to the granting of Goodyear's first synthetic patents in 1927.

As a result, the G.T.M. today is able to specify synthetic rubber products of standout quality. Some, especially for service where exposure to oil, gasoline or solvents is involved, set new performance standards.

Others, like the new Goodyear Style SS Conveyor Belt for abrasive conditions, are comparable to the best prewar quality. And still others, like our new Resoweld tank lining, perform tasks never handled satisfactorily by natural rubber.

Yes, it will pay you to consult the G.T.M. — if you want industrial rubber products that will maintain your speeded-up production schedules. To bring him to your office, phone the nearest Goodyear Industrial Rubber Goods Distributor — or write Goodyear, Akron 16, Ohio or Los Angeles 54, California.

Resoweld—T.M. The Goodyear Tire & Rubber Company

GOODYEAR INDUSTRIAL RUBBER PRODUCTS
are tested and proved in the
WORLD'S FINEST RUBBER RESEARCH LABORATORY

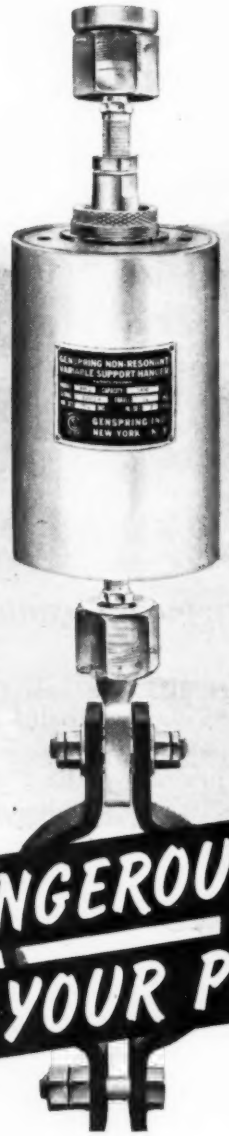
The new Goodyear Research Laboratory, where 20 years' experience in synthetics and 46 years' skill in rubber engineering combine to produce better industrial rubber products.

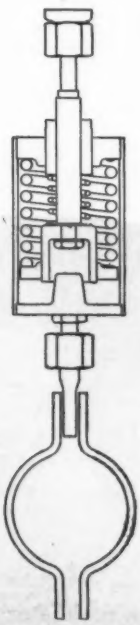
GOODYEAR
THE GREATEST NAME IN RUBBER

Let's all Back the Attack with War Bonds

The NON-RESONANT GENSPRING NR HANGERS

GENSPRING NR HANGERS





WELDED STEEL • CONFORM TO PRESSURE PIPING CODES • PRECISION MACHINED • STURDY • ADJUSTABLE FOR ACTUAL OPERATING CONDITIONS • LOW FRICTION

PREVENT DANGEROUS VIBRATIONS IN YOUR PIPING

NON PRELOADING

NR SWAY BRACES, unlike those with springs, do not offer any resistance to slow thermal movements. Add no load to piping.

VISCOUS DAMPING

When vibration occurs, NR SWAY BRACES do exert a damping force proportionate to frequency, thus conforming to well established shock absorbing methods of controlling vibration.

END CONNECTIONS

Universal motion, unrestricted in any lateral direction including rotation about sway brace centerline. No backlash when forces reverse. Precision machined.

Piping Suspension System and NR SWAY BRACES...

NR HANGER load scale is *not fixed, but calibrated for each spring*, thus eliminating error due to manufacturer's variation of spring stiffness.

SCALE

Conservative design for long life and low maximum stress. Completely enclosed and protected against corrosion. Designed for minimum variability of 20% (loss or gain in supporting force of 10% in ½ inch travel). Positive guiding and low friction through precision oilless bronze bushings. Loads on NR HANGER springs always concentric with spring centerline, important because *¼ inch eccentricity of force reduces safe carrying capacity of a helical spring by 10% and spring stiffness by about twice that much.*

SPRINGS

Universal motion unrestricted in any lateral direction including rotation about hanger centerline. No backlash when forces reverse. Precision machined and protected against corrosion.

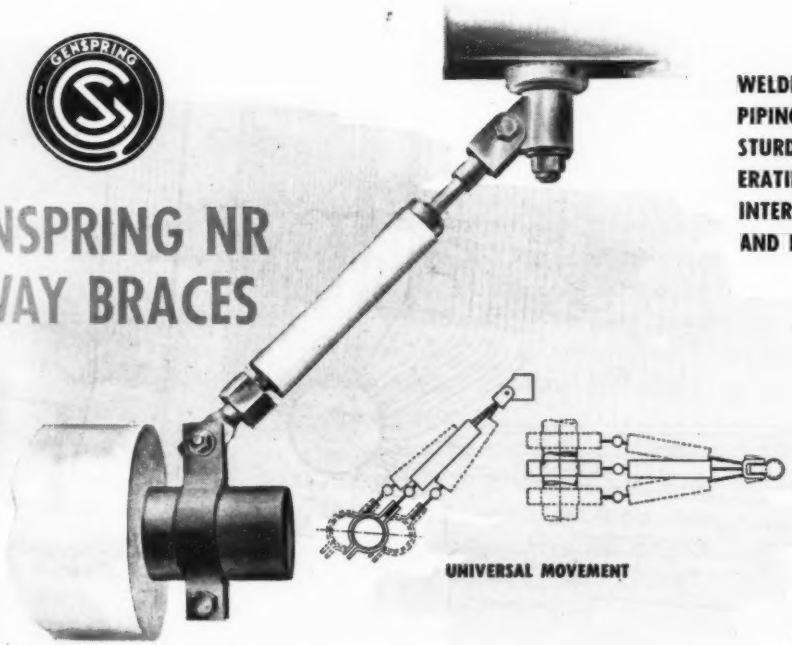
END CONNECTIONS

The *first* low headroom hanger, with 10½ inch minimum center to center of couplers.

LOW HEADROOM

GENSPRING

GENSPRING NR SWAY BRACES



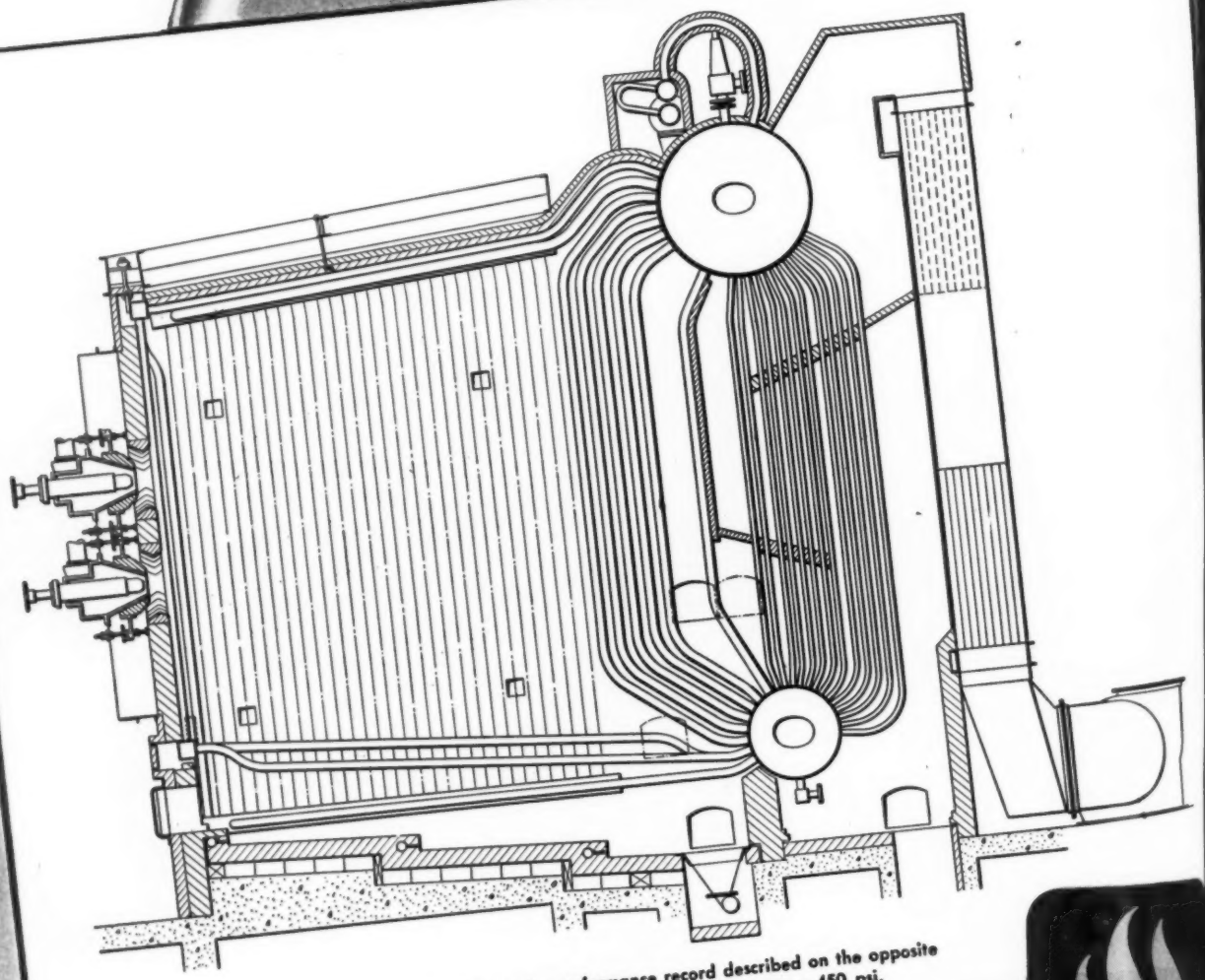
UNIVERSAL MOVEMENT

WELDED STEEL • CONFORM TO PRESSURE PIPING CODES • PRECISION MACHINED • STURDY • ADJUSTABLE FOR ACTUAL OPERATING CONDITIONS • LOW FRICTION • INTERNAL PARTS COMPLETELY SEALED AND LEAKPROOF

Write for your copies of Genspring Bulletin 101, and "Suspension of High Temperature Piping" by J. Kaye Wood, as reprinted from "Power".

GENSPRING INC.
500 FIFTH AVE., NEW YORK 18, N. Y.

AROUND THE CLOCK



This is the unit responsible for the performance record described on the opposite page. Capacity — 43,000 lb of steam per hr. Design pressure — 450 psi.

C·E

7 days a week

...and never a forced outage

About five years ago an eastern paper board company, confronted with the necessity of replacing over age, inefficient boiler equipment, installed a C-E Steam Generator, Type VU. The plant's maximum steam requirement, at the time, was about 43,000 pounds per hour, and this unit was guaranteed to supply it. Pulverized fuel firing was selected using a C-E Raymond Bowl Mill and two C-E Horizontal Burners equipped to burn oil as an alternate fuel if desired.

The purchaser had planned to use the old equipment for standby service, but almost from the time of its initial operation the C-E Unit took over the entire plant load. "Took it over" so completely and reliably that within a year the other equipment was abandoned.

Then wartime demands stepped up the plant output to the now familiar 24 hours a day — 7 days a week basis. Steam needs rose accordingly. How well this C-E Unit responded is evident from the following statement of a company official.

"This unit does all that we ask of it — always. It works around the clock — 7 days a week for months on end until we shut down the entire plant for scheduled inspection and maintenance of all equipment. We need an average of between 50,000 and 60,000 lb of steam per hour and we're getting it — with never a forced outage."

Thus the extra values — the reserve — in C-E design and construction are demonstrated again. The same type of performance repeated in many different war plants has established the ability of C-E equipment to meet every demand with consistent dependability. You can assure this quality of performance for your *peace-time* steam needs — Specify C-E. A-777

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N.Y.

*COLOR..

TIDE WATER LUBRICANIA

DEFINITION: For practical purposes, the color of an oil is expressed as a "number" which is determined by matching the light transmitted through a pre-determined depth of oil with that same light transmitted through numbered and standardized glasses or disks.

EXPLANATION OF TESTS USED: The American Society for Testing Materials have selected two instruments for determining the color of petroleum products. These instruments are:

(1) **The Saybolt Chromometer** for making color determinations on the lighter oils.
(2) **The Union Colorimeter** for determining color on the "pale-straw" and darker products.

THE SAYBOLT CHROMOMETER consists of two vertical glass tubes. One of these tubes is of plain glass, open at both ends with provision for holding one or two colored glasses or disks at the lower end. The other tube is closed at the lower end with a colorless plate and is provided with a drain cock. This tube is graduated. A mirror reflects light through the oil and the tubes into an optical prism-eye piece for matching the light passing through the oil with the light passing through the disks. The color scale for light oils varies from minus 16 to plus 30.

THE UNION COLORIMETER: In the Union Colorimeter the N. P. A. or A. S. T. M. color of the oil is obtained by matching one of a series of fixed color standards against a sample of oil. The comparison is observed through a circular aperture at the end of a long rectangular box. The color standards are mounted at one end of the box in a vertical magazine which may be moved up and down by means of a knurled hand knob operating a ratchet and gear.

The method used for matching colors on both the Saybolt Chromometer and the Union Colorimeter follow a carefully prescribed procedure outlined under A. S. T. M. Designations D156-38 and D155-39T respectively.

SIGNIFICANCE: Color is of importance in the case of certain light petroleum fractions, particularly products used in dry cleaning or in the textile industry, where the use of colored products might discolor the fabric being treated. The chief significance of color as applied to the darker oils is in the fact that it is a generally accepted index of the uniformity of a given grade or brand. In these oils, color cannot in any way be related to the "performance characteristics" of the oil as a lubricant.

INDUSTRIAL TYCOL OILS-GREASES

DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE **TYCOL**

* This is the 8th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

All Tycol oils and greases are subject to rigid tests to control the uniform quality of manufacturing. They are manufactured in a comprehensive line so as to meet every specific operating requirement. It is the combination of the unvarying high quality of Tycol products and the scope of the line that makes possible the unexcelled performance of Tycol lubricants for Industry.

TIDE WATER ASSOCIATED OIL COMPANY

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.

Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

INDUSTRIAL LUBRICANTS

Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 2

"Phosphorized Admiralty"—and its dezincification-resistance

The qualities of this condenser tube material as confirmed in actual performance and reported by Scovill engineers

Millions of pounds of Phosphorized Admiralty are now in use in heat exchanger and condenser service — some since 1939 when this Scovill material was first introduced. Phosphorized Admiralty has built up a remarkable performance record and its resistance to dezincification is of a high order.

An explanation of this may be of interest.

The *dezincification-resistance* of Phosphorous bearing brasses is well known.

The *marked influence* of a very small percentage of Phosphorous in controlling this form of corrosion of Brass has been the subject of considerable research. In this connection, much interest has been shown not only in the actual ability of Phosphorized Admiralty and other phosphorized brasses to inhibit dezincification but in the reasons for the beneficial effect imparted to such alloys by Phosphorous.

Several theories have been advanced and much investigational work has been carried out to explain the inhibiting action of Phosphorous in brasses under service conditions which would normally result in dezincification of the metal. This problem will be better understood by a consideration of the properties of Phosphorous and its compounds.

Phosphorous is non-metallic in character and enters into combination with Oxygen to form a series of oxides. From Phosphorous and its various oxides, a number of metal salts may be obtained. With the exception of Sodium and Potassium salts, these metal compounds are, in general, insoluble in water. In some cases, these salts exhibit colloidal properties to some degree. The end product of the oxidation of Phosphorous gives ortho-phosphates and, in the presence of sufficient Oxygen, ortho-phosphates will be found.

One interesting detail in connection with the compounds of Phosphorous is the behavior of Tin and Phosphorous when they are present in the same solution. Tin Oxide in colloidal solution readily takes up or absorbs Phosphates and this reaction usually hastens the precipitation of Tin in a very insoluble form. It was earlier believed that this reaction was entirely of a colloidal nature, but, recently, it has been shown that a definite compound of Tin Phosphate is formed, at least in certain conditions. This particular reaction between Tin and Phosphorous compounds is stressed because it has been noted in a research on the dezincification of brasses that the presence of Tin in itself retards dezincification to some extent; but the addition of Phosphorous (as in Phosphorized Admiralty metal) is necessary to prevent dezincification of the alloy.

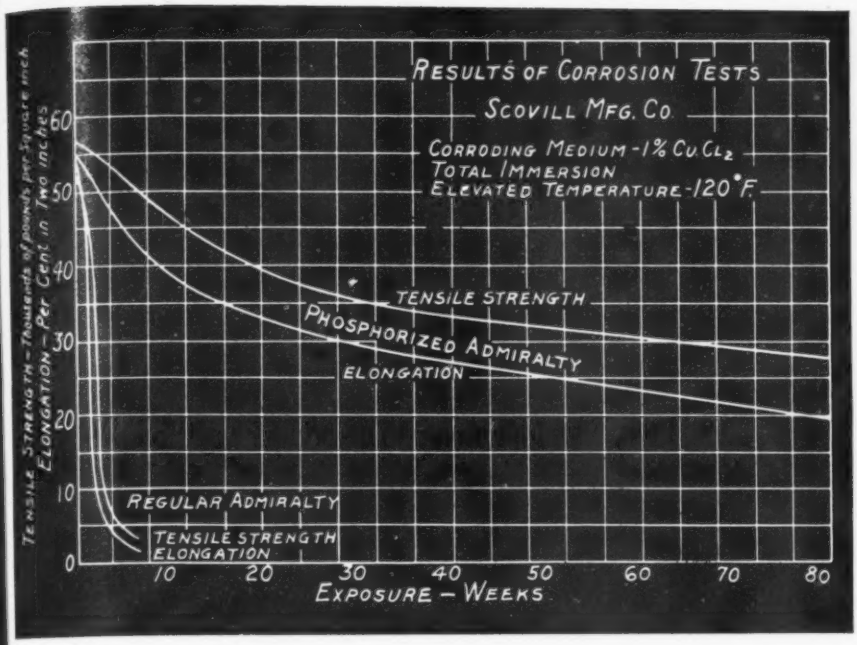
If the foregoing discussion of the formation of insoluble and colloidal metal salts of Phosphorous is remembered, the dezincification-resistant property imparted to Brass by the addition of Phosphorous can more readily be explained. In services where dezincification of Admiralty metal or other brasses has been experienced, the phosphorous content of the dezincification-resistant alloys probably promotes the formation of a protective film (in the nature of a metal phosphate or phosphide such as Copper Phosphide Cu_3P_2), which coats the metal surface at initially corroded areas and arrests further action at such areas.

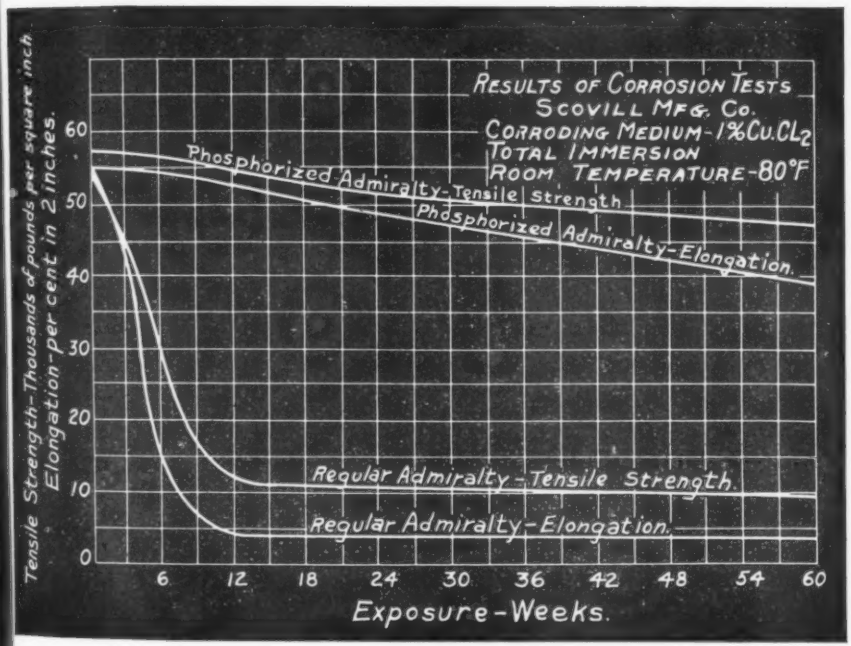
The reactions which take place in the formation of the phosphorous containing film may or may not be complex in nature, as may be anticipated from the above remarks on the chemical reactions of Phosphorous. Thus, in the early stages of corrosion, Phosphorous, together with Copper, Zinc and Tin may pass into solution and the Phosphorous may then combine with certain of the metal ions in solution to form an insoluble compound which coats the metal surface as a stable impervious film. The formation of this compound may involve nothing more than introduction of ions of the reacting elements into the solution, followed by precipitation and deposition of certain combinations of such ions on the metal surface.

It is probable, however, that a more complex series of reactions takes place and may be better explained by considering the existence of colloids in the medium in contact with the metal surface. In this connection, it may be pointed out that very minute quantities of colloids in a solution often times produce a profound change in the behavior of such solutions. In the plating of metals, for example, colloids in the plating bath may alter the type of plate, may prevent plating altogether, or may change the conditions (current density, voltage, etc.) at which satisfactory plating may be carried out. The subject of plating is introduced in this discussion of colloids because dezincification may be looked upon as a plating operation in which Copper is plated upon the brass, usually in the form of a porous, brittle mass. In the case of Phosphorized Admiralty tubes, colloidal Tin Phosphate or other metal phosphates may play an important part in preventing dezincification of the alloy.

This discussion of the part which Phosphorous plays in preventing dezincification of Admiralty metal and other Brasses has necessarily been brief and has been presented only because of the interest which has been shown in this subject.

Wherever dezincification of Admiralty metal tubes has been a serious corrosion problem, the use of Phosphorized Admiralty metal tubes is suggested. This alloy combines the general excellent corrosion-resistant properties of Admiralty metal, a desirable fine grain structure of




RESULTS OF CORROSION TESTS
SCOVILL MFG. CO.
CORRODING MEDIUM - 1% Cu.Cl2
TOTAL IMMERSION
ROOM TEMPERATURE - 80°F
Phosphorized Admiralty - Tensile Strength.
Phosphorized Admiralty - Elongation.
Regular Admiralty - Tensile Strength.
Regular Admiralty - Elongation.
Tensile Strength - Thousands of pounds per square inch.
Elongation - per cent in 2 inches.
Exposure - Weeks.

developed primarily for oil refineries and gasoline plants because in those places the phenomenon of dezincification is pronounced and widespread, it is equally applicable to any situation where dezincification of Admiralty is a problem — particularly at elevated temperatures.

"Phosphorized Admiralty tubes" for condenser and heat exchanger service are covered by patent 2,224,095 and can be legally supplied only by the owner of this Scovill Manufacturing Company patent, or one of its licensees.

Scovill Offers 3 Services to Tube Users

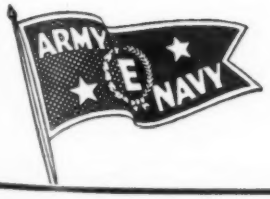
1. Information, like that appearing on these pages, which will help keep engineers informed of recent developments and recent thinking in the matter of condenser tubes. The new "Condenser Tube Booklet" — a part of Scovill's *Service in Manuals* is available, free, from Scovill Manufacturing Company, 13 Mill Street, Waterbury 91, Connecticut.

2. Research in Metals is another Scovill service, intended to establish new knowledge about metal alloys which will help develop better performance on the part of Scovill condenser tubes. Scovill *Service in Metals* also includes the testing of raw materials, the testing of finished tubes before shipment and the analysis of problems arising from tubes in service.

3. Individual recommendations for each customer's requirements constitute the third Scovill service. *Service in Men* brings you a wealth of experience to help you obtain the best results and to eliminate trouble causes.

the finished tubes, favorable physical properties and a very definite improvement over Admiralty metal in its very marked resistance to dezincification.

While Phosphorized Admiralty was



Limitation order L-154 issued by the OPM, limits the use of nonferrous condenser tubes in land power stations to Muntz metal for fresh water plants, and Admiralty metal for salt water plants. No nonferrous metals containing more copper and more tin than these two are permitted by the order.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

DETROIT STOKER IN McCORD PLANT

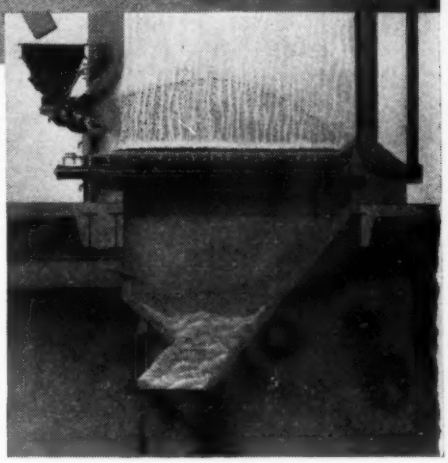
MAKERS OF THE NEW AMERICAN HELMET

McCord Radiator & Mfg. Co., who in peacetime serve Power, Automotive, Refrigeration, and Air Conditioning industries, developed quantity production methods on the famous new American Helmet—that tough, hard piece of armor that has saved lives—prevented so many wounds.

This helmet, worn by American Forces everywhere, is larger than the World War I "tin hat"—provides more protection and is more comfortable to wear.

McCord Radiator & Mfg. Co. is a long-time user of Detroit Stokers—four installations in three McCord plants.

The President of McCord Radiator & Mfg. Co. and the Works Manager starting the fire in the new Detroit RotoStoker.



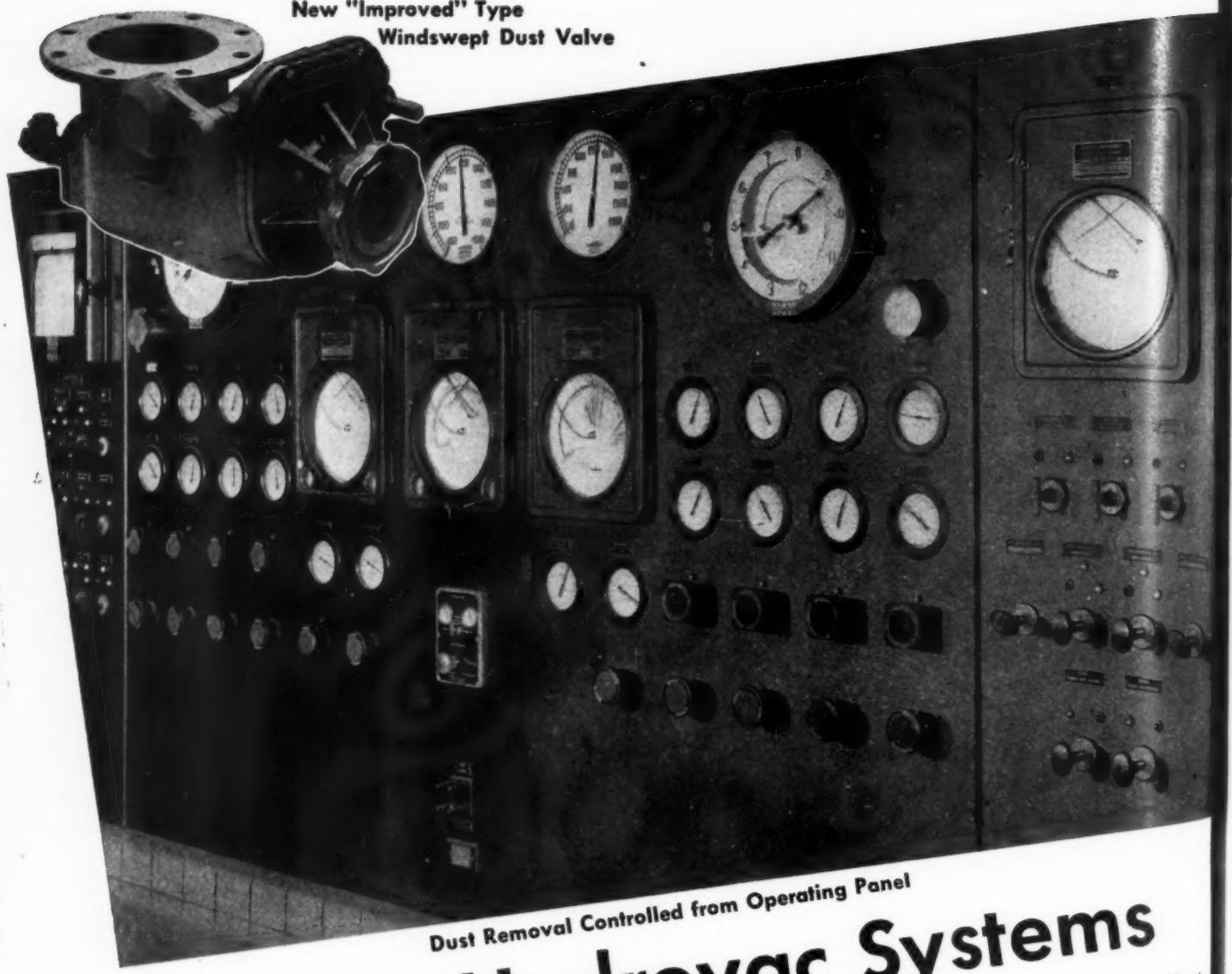
Detroit RotoStoker successfully burns a wide variety of bituminous coal—handles fluctuating loads with uniform steam pressure.

Plant No. 1 of McCord Radiator and Mfg. Co., Detroit.

DETROIT STOKER COMPANY General Motors Bldg. Detroit, Michigan

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

New "Improved" Type
Windswept Dust Valve



Dust Removal Controlled from Operating Panel

"Three" Hydrovac Systems

Full Automatic—By the simple throwing of a switch on the operating panel, one Windswept Dust Valve after another (behind the last boiler pass, beneath the air preheaters or economizers, beneath the dust precipitators, and at the base of the stack) opens, feeds dust and closes automatically. After dust is removed from all hoppers, the system automatically shuts down. No labor for attendance required.

Semi-Automatic—Any Windswept Dust Valve throughout the plant may be individually operated by a switch on the operating panel. Vacuum gauge indicates when each hopper is cleaned of dust.

Manual—One man goes to each Windswept Dust Valve and opens and closes each by throwing lever or operating a hand chain. Vacuum gauge indicates dust condition in hopper.

The A-S-H Windswept Dust Valve has been an outstanding success for years, but have you seen the new "Improved" Type, pictured in the top left-hand corner of this page? If not, write us.

HYDROJET HYDROVAC

ALLEN-SHERMAN-HOFF CO. 227 S. 15th Street Philadelphia 2, Pa.

The Boy Colonel from Utah

Written Specially for the Allen-Sherman-Hoff Co.

BY *Lowell Thomas*

Famous Radio News Commentator and Author

Shortly after Pearl Harbor the wire services carried a story from England about the American Eagle Squadron of the Royal Air Force, which caused a good deal of snorting in the U. S. A. Long before we were catapulted into the war, that squadron of American Volunteers was fighting brilliantly for King George, and even our official neutrality could not prevent us from being proud of them. In December, 1941, we learned that the leader of the Eagles was a bold, husky young Westerner only 21 years old, who had been washed out of the Air Corps of Uncle Sam's Army.

People who read that story demanded to know "How come?" They wondered whether our Air Corps officers could not recognize a potentially great young flyer when they saw one.

It turned out that the facts were not as bad as they looked. Chesley Gordon Peterson was dropped from the U. S. Army Air Corps in 1939 because he was too young, according to the regulations then in force. Those regulations, of course, have long since been changed.

If Peterson had been born a century ago, he would undoubtedly have become an explorer. From his boyhood he showed the zest for adventure and the curiosity of which discoverers are made. When he was only fourteen, he ran away from home because his father would not allow him a rifle. His home was near Santaquin, Utah, in the heart of good Mormon farming country. Though a bit of a rebel, he was no loafer but a student leader in high school. In a debating contest, as a lad of seventeen, he stood up in public and told the elders of that farm community that farming as a career was not good enough. Evidently he made the elders like it, because they awarded him first prize for that speech. A schoolmate delivered an oration in praise of farming as a life work. To him they gave the second prize.

However, when Peterson graduated he suppressed his inclinations sufficiently to study agriculture at Brigham Young University, at Provo, Utah. He even held a job as assistant supervisor of the U. S. Department of Agriculture. His taste for variety he partially satisfied as a corporal in the Utah National Guard.

But two years of that were all he could endure. He enlisted in the U. S. Army Air Corps, adding a couple of years to his age, and was doing well until his commanding officer learned that he was only nineteen. (The Marines and the Navy now take some boys at seventeen.)

If he was not permitted to fly, thought Peterson, maybe helping to build planes was second best. So he went to work in the Douglas aviation plant at Santa Monica, California. But that was too dull for him. After four months he learned that the Royal Canadian Air Force was taking young recruits and glad to get them. He went to Ottawa, enlisted in the summer of 1940, and a couple of months later, on his twentieth birthday, was sent to England where he became one of the original eight members of the Eagle Squadron, now as famous as was the Escadrille Lafayette from 1915 to 1917.

Most of the other Eagles were older than Peterson, but his promotion was spectacular. After he had shot down his fifth enemy aircraft, the British awarded him the Distinguished Flying Cross.

In December, 1941, word came that he had become leader of the Eagle Squadron. In August, 1942, he fought in the Battle of Dieppe, where he was wounded. After that show he obtained the D.S.O. for conspicuous gallantry in action.

In September, 1942, the United States High Command realized that an officer who might be of great value to the armed forces of the U. S. A. was serving the British.

Peterson obtained release by the British, and was commissioned a major in the Army of the United States which assigned him to duty with the Eighth Air Force with headquarters in Great Britain. That was in September, 1942. Only one month later, Chesley Peterson was promoted to temporary Lieutenant-Colonel, being only twenty-two years old.

He had hardly been in the Air Force of his own country for six months, when the Army awarded him an air medal. He got it for exceptionally meritorious service in no fewer than ten separate fighter combat missions over Fortress Europe. The general commanding the Eighth Air Force remarked in the citation that "the courage, coolness and skill displayed by this officer upon these occasions were of the highest order and reflect great credit upon himself and the armed forces of the United States."

One month later, this spectacular young fellow received the first Oak Leaf Cluster to the Air Medal, and one month later still, a second Oak Leaf Cluster. Evidently in one month alone he had flown over Europe ten times because the citation for the second Cluster mentions "meritorious service in aerial flight in the completion of ten operational sorties." In one of those he was wounded again, because in April, 1943, he was awarded the Purple Heart.

Probably Peterson himself could not tell you how many times he sallied forth in his plane over Nazi-occupied Europe. Paladins of that calibre are not over-addicted to talking, though this extraordinary fellow from Santaquin, Utah, is by no means tongue-tied.

His most conspicuous exploit so far was accomplished in May, 1943. He was leading a formation of fighter planes which was escorting a force of heavy bombers. His wing man had motor trouble and was forced to drop behind. At that moment, Peterson spied eight enemy airplanes about to swoop down on the bombers. The citation reads: "With utter disregard for his personal safety and without assistance, he immediately attacked the eight enemy aircraft." The citation goes on to report that he "probably destroyed one and damaged another." In any event, he attacked with such fury and valor that he broke up the formation of Nazi planes and sent them to the right-about. And thereby he "contributed largely to the safety of the bomber aircraft and the successful completion of their mission." For this Chesley Gordon Peterson received the Distinguished Service Cross in July, 1943. By the time this gets into print, he may have been awarded some more decorations. Up to July, 1943, he had two from the British government, three from his own country, plus two Oak Leaf Clusters to his Air Medal.

In October, 1943, the War Department promoted Chesley Gorden Peterson to temporary rank of colonel, a colonel aged twenty-three years!

Which makes something for Mr. and Mrs. Brigham Peterson of Santaquin to talk about on these long winter nights.

WRITE FOR LOWELL THOMAS BOOKLET

Following the publication of a few of these Lowell Thomas stories, we plan to publish the entire group in booklet form. In order to help us decide on how many to print, we'd appreciate your writing us now, so that we can reserve a copy for you. No obligation, of course.

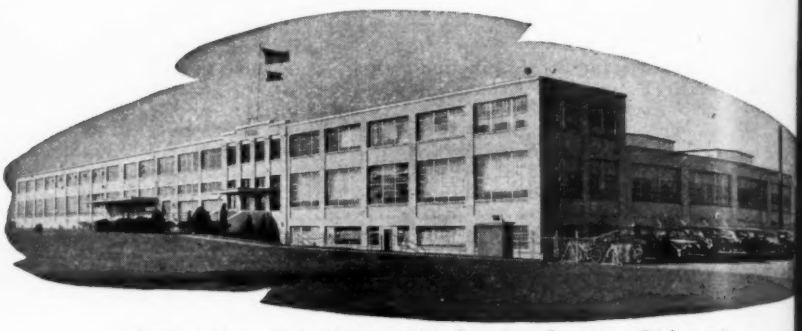
HYDROSEAL HYDRO BIN

OFFICES AND REPRESENTATIVES IN MOST PRINCIPAL CITIES

Boiler Capacity Up . . .

Fuel Cost Down

WHIPPLE JACOBS, *President*
Belden Manufacturing Company



Exterior view of the Belden Manufacturing Company, Richmond, Indiana, well known makers of insulated copper wire, cable and cordage.

IRON FIREMAN STOKER Saves Over $3000 a Year at Belden Manufacturing Co.

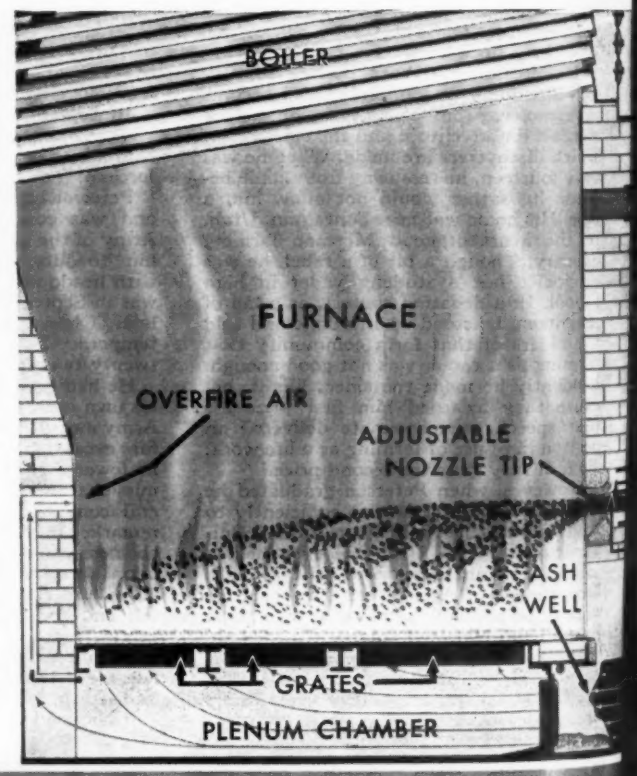
★ "In addition to providing a required increase in the capacity of our old boilers, we have reduced operating costs by $3,293 annually," reports D. D. McQuiston of the Engineering Department of Belden Manufacturing Company.

The Iron Fireman Pneumatic Spreader stoker model as used by Belden permits the use of local and lower cost coal, a vital advantage now when the transportation bottleneck presents serious difficulties. This greater efficiency and lower fuel costs are typical of thousands of war production plants that have changed to automatic coal firing.

Convert to Automatic Coal Firing Now

If your power or heating plant is now oil-fired, or if you operate an essential business or industry, you are eligible to apply for an Iron Fireman stoker under WPB regulations.

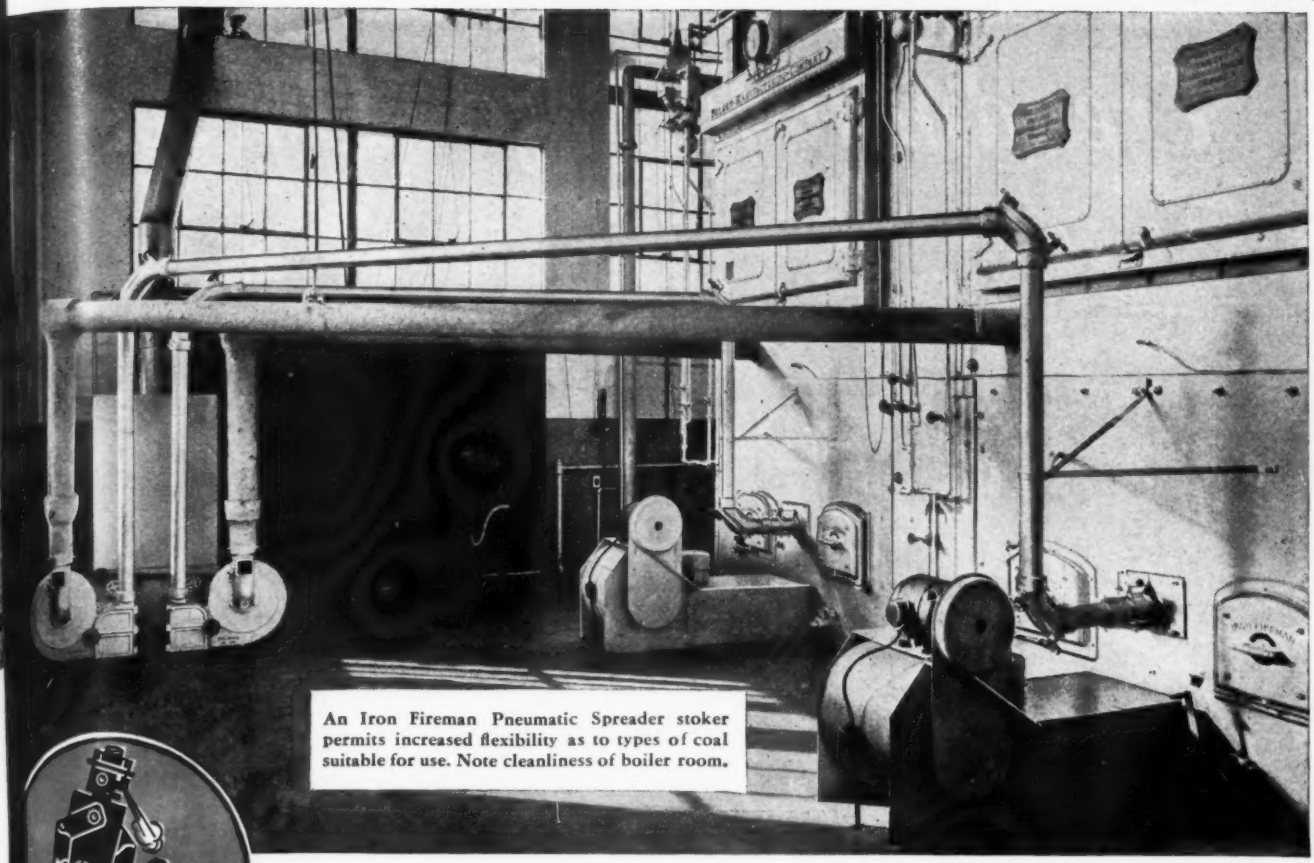
Phone, wire or write Iron Fireman Manufacturing Company, 3512 West 106th Street, Cleveland, Ohio.



IRON FIREMAN

THE IRON FIREMAN

Automatic Coal Stoker



An Iron Fireman Pneumatic Spreader stoker permits increased flexibility as to types of coal suitable for use. Note cleanliness of boiler room.

THE IRON FIREMAN

PREHEATED AIR PIPE

Coal Conveying Pipe

Nozzle Adjustor

Coal Nozzle

Forced Draft Fan Motor

Transfer Housing and Conveyor Fan Housing

Connection for Combustion Control

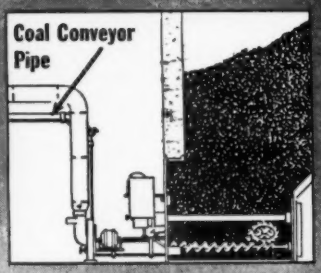
Conveyor Fan Motor

FORCED DRAFT FAN

COAL HOPPER

BUNKER-FEED MODELS

Coal is conveyed automatically from the bunker to the boiler

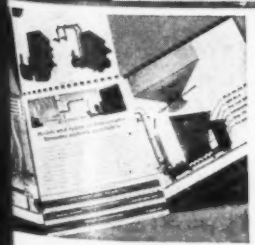


Worm Housing Cleanout

Feed Worm

Coal Feed Motor

Transmission



FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3512 W. 106th Street, Cleveland, Ohio.

Treadmill for 150 "Horses"

THAT'S WHAT that 150 hp synchronous motor armature is — a treadmill. Visualize 150 horses "kicking" it around at 1200 rpm. It receives *terrific* forces!

Yet that Allis-Chalmers "Indestructible" Rotor swinging over for assembly with its stator is more than able to take such punishment.

Field coils have been wound *directly* on poles . . . special clamps been installed on coils to prevent distortion . . . 1001 precautions been taken so that every detail and dimension of the rotor is *right*.

No machines exist that can do *all* those jobs; no machines are known that can factory-test how well and truly Allis-Chalmers workmen did them. There's only one test . . . wait 5, 10, 15 years — and *see*.

And that's the test that has made Allis-Chalmers motors a by-word of industry: *"You can depend on Allis-Chalmers Motors!"*

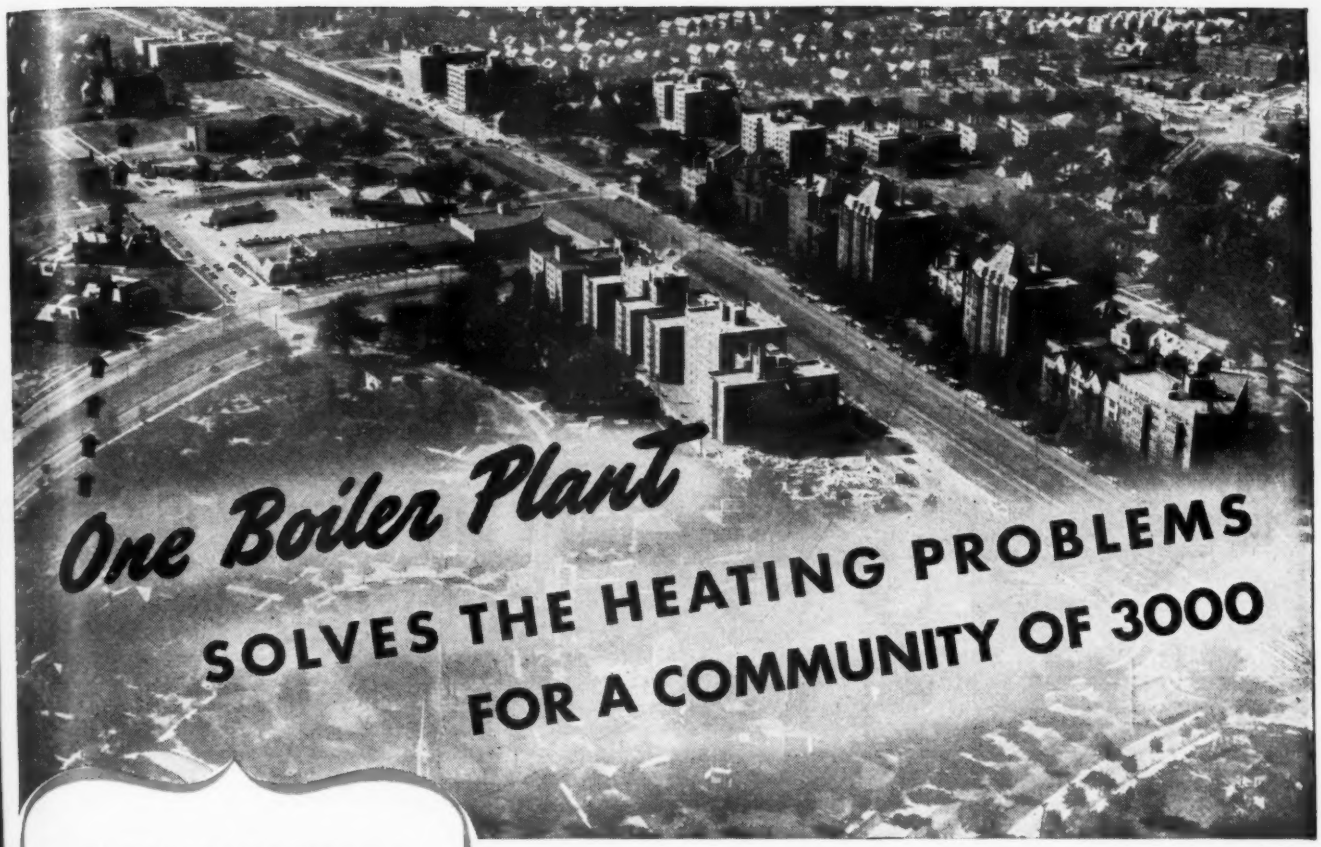
Yes, the most important thing about that rotor — more important even than Allis-Chalmers' advanced engineering and manufacturing procedure—is that *it was built by men at our Norwood Works who know they have a big personal stake in every Allis-Chalmers motor.*

They know that when they build great motors for you, they're making *friends* . . . and that no company and its employes can have too many of them! ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 1713

Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS



One Boiler Plant SOLVES THE HEATING PROBLEMS FOR A COMMUNITY OF 3000

BUILDINGS SERVED BY CENTRAL HEATING PLANT AT SHAKER SQUARE

- Apartments and multiple dwellings—housing approximately 700 families.
- Branch bank.
- Theatre seating 1,500.
- Tavern restaurant and Inn.
- Buildings containing 45 stores and 30 office suites.
- Large restaurant.
- Automobile Service Stations.

The Heating Plant is modern and fully automatic—requiring a crew of only 5 men. During the last complete heating season it consumed 8,000 tons of coal and produced approximately 140,000,000 pounds of steam.

Section of Ric-wiL prefabricated insulated steam conduit being lowered into shallow trench for steam connection to a new apartment at Shaker Square.

Central Heating at Shaker Square, Cleveland, owned and operated by the Shaker Co. suggests an ideal plan for post-war community development.

Fifteen years ago the Shaker Square district was planned by the Van Sweringen interests along lines now being considered by many communities for post-war development. A heating plant large enough to serve the entire district was erected and Ric-wiL underground steam conduit was installed for future connections . . . Time has proved the wisdom and foresight of the original planners. Today, this one boiler plant supplies heat and hot water through more than 10,000 feet of Ric-wiL Conduit to 700 apartment and multiple family dwellings, 45 stores, 30 office suites, a large tavern, a restaurant, a bank, a large theatre and 2 service stations.

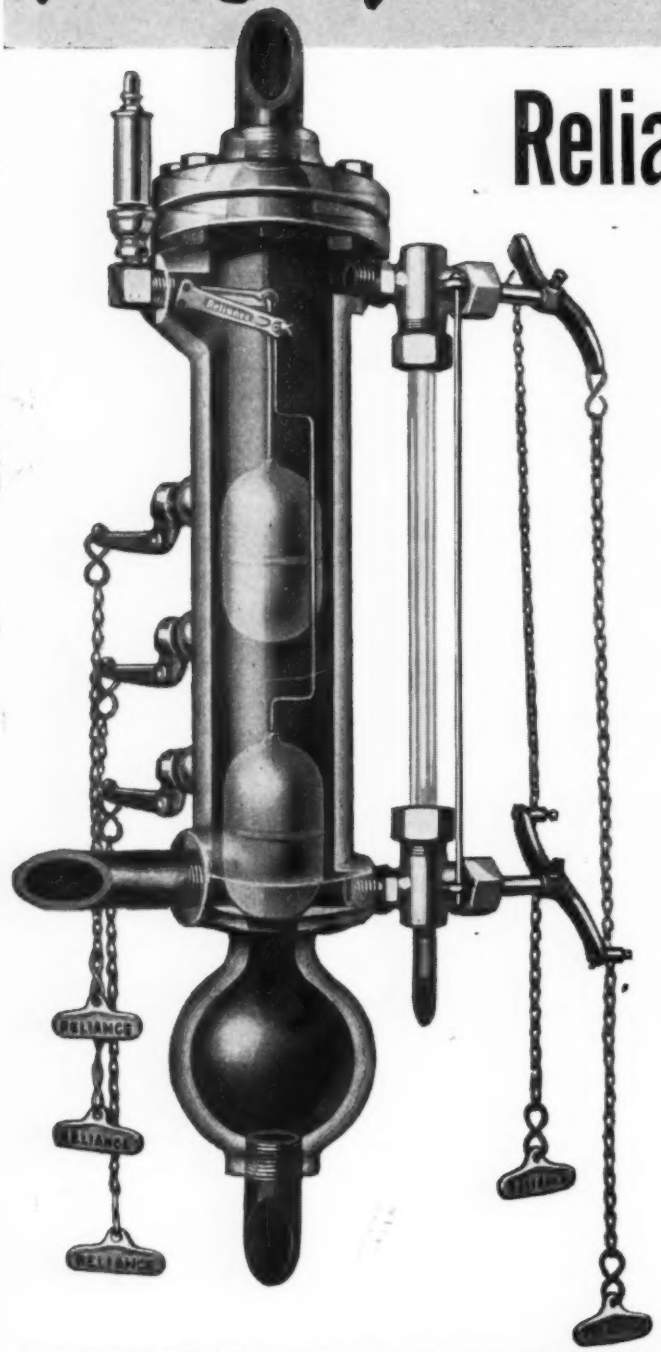
Any Community Can Enjoy These Advantages:

- Savings of 15% or better in overall fuel consumption.
- Elimination of furnace or boiler tending by consumer.
- Promotes cleanliness in buildings heated.
- Provides extra room in building basements.
- Decreases fire and explosion hazard.
- Reduces smoke and soot, provides cleaner, healthier, community.
- Eliminates private coal delivery and ash removal.
- Gives uniform, clean heat quickly, whenever needed.

For information about Ric-wiL Conduit for central heat distribution get in touch with your nearest Ric-wiL agent or write to us direct.

RIC-WIL INSULATED PIPE CONDUIT SYSTEMS
THE RIC-WIL COMPANY · CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES

Keeping Step



Reliance Water Columns fill any need you'll have for basic boiler water level supervision

● Sooner or later you'll be studying plans for reconversion, expansion, modernization—whatever fits your situation in the industrial or power-producing field. When you come to prime power units—the boilers—you're likely to find you have a need for additional or different water columns—and other boiler water level safety devices.

It will pay you to have basic data on Reliance Equipment at hand for consideration. For Reliance stands ready to supply any water column you need—and any gage equipment—for low or high pressures for all types of service.

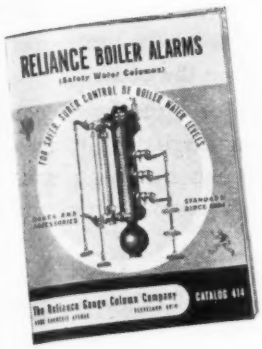
Since 1884, Reliance has maintained leadership in Boiler Safety Device development and manufacture. Water columns with Alarms, operated by the original *instantaneous* alarm mechanism, have helped to fortify power plants against the consequences of boiler water failure for billions of operating hours.

Selected as standard equipment by many boiler manufacturers and consulting engineers, Reliance Water Columns assure you the utmost of dependability—help protect your reputation for efficient low-cost power plant operation. . . . Write for catalogs, or get in touch with your nearest Reliance Representative.

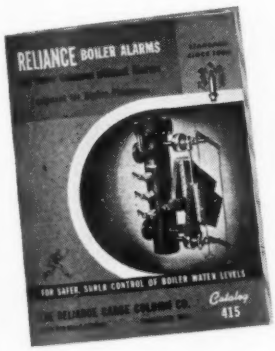
60 Years of Boiler Protection

1884-1944 Reliance

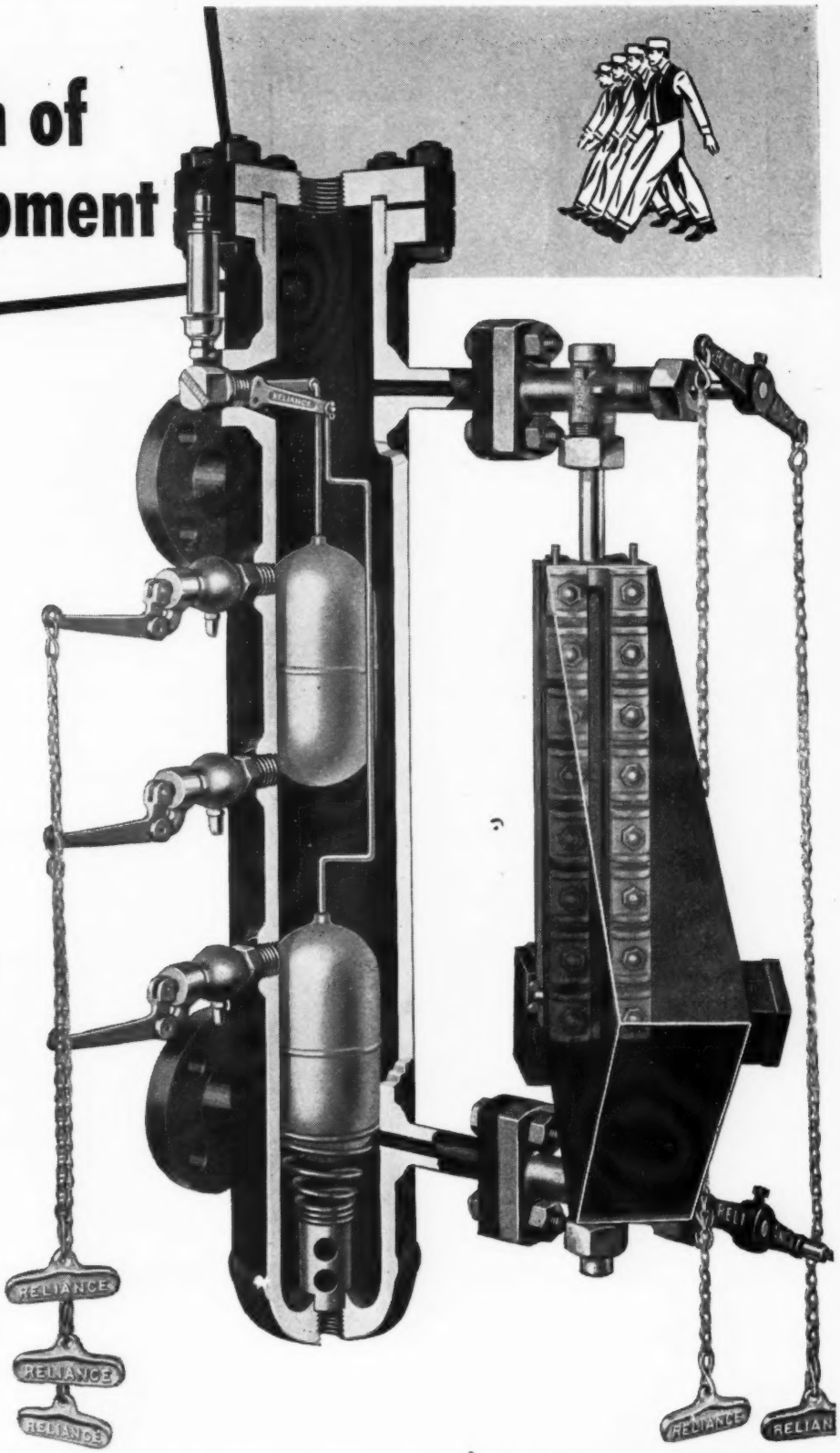
in the march of ower development



Catalog 414 describes Reliance Safety Boiler Water Columns for pressures up o 250 pounds—also water gages and ccessories and gage illumination equip- ent. Illustrates approved water column ook-ups and actual installations.



atalog 415 gives you a comprehen- ve description of Reliance Safety Boiler ater Columns and Water Columns ithout alarms for pressures above 250 ounds—also water gage equipment, ap- oved hook-ups and newest techniques for high pressures.

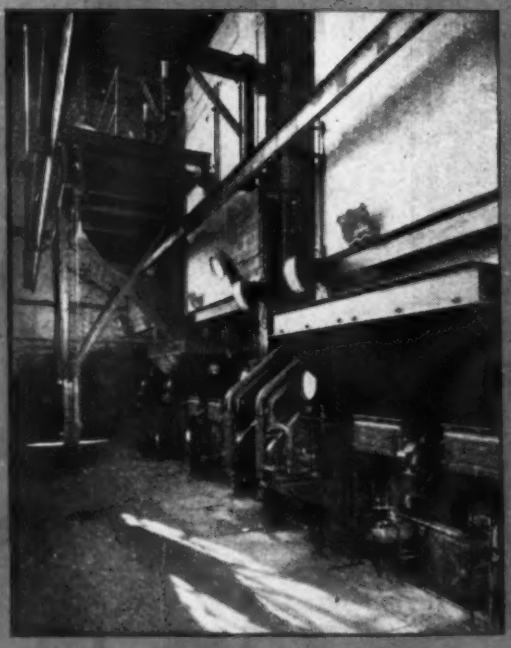


OILER SAFETY DEVICES

THE RELIANCE GAUGE COLUMN CO.
Cleveland, Ohio

★ ★
Buy More War Bonds

FAIRFIELD



● The value of coal as a power fuel is greatly enhanced with an efficient—clean—foolproof method of handling and storing the coal.

The Fairfield Silo System for handling coal, automatically, from car to storage to pulverize or stoker and the Fairfield ash handling units provide a complete modern system of coal and ash handling.

Fairfield not only engineers this system but builds and installs it—thus you place the full responsibility for the entire system in an organization which not only has an intimate knowledge of the field but a wide experience in installing many successful units.

The Silos are made of vitrified tile—are of circular design—and are located outside of the boiler room. No changes in present structure are required—all dirt is kept outside the boiler room.

Two elevating methods are illustrated. At the top of the page is shown the bucket elevator method and below the skip hoist is pictured. For distributing coal to stokers the weigh larry is frequently used.

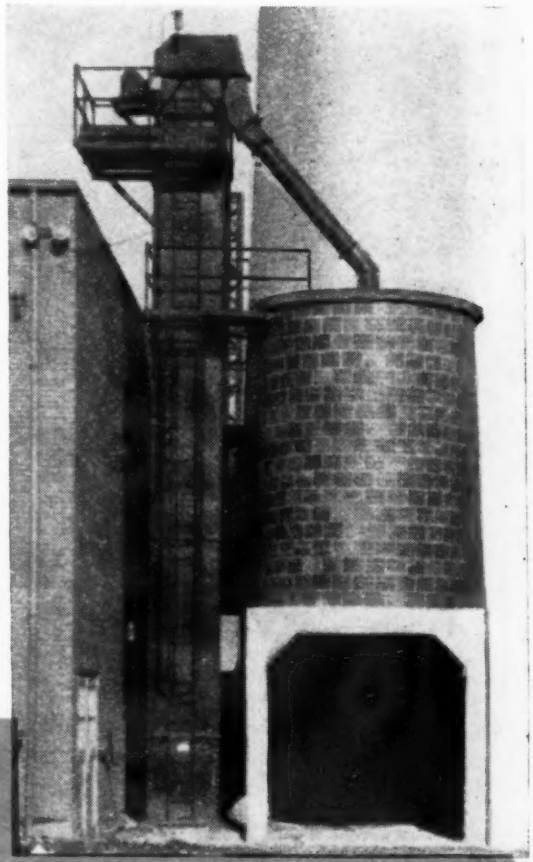
SKIP HOIST

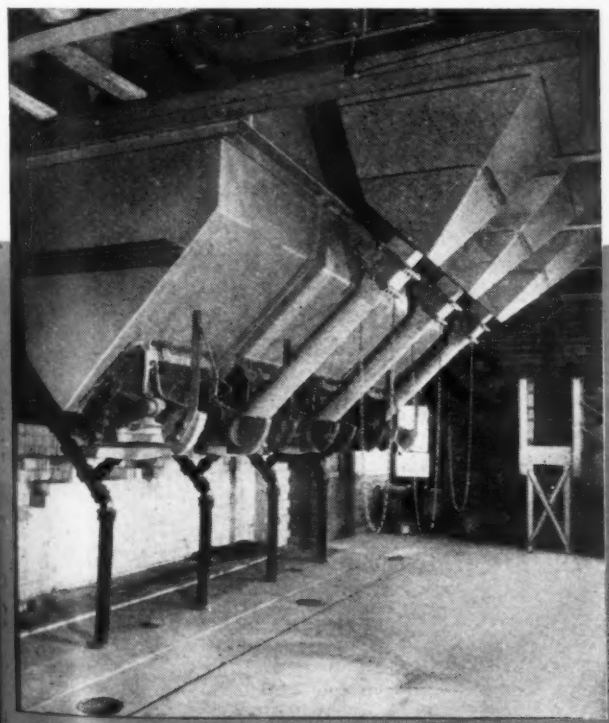
The Skip Hoist shown is handling 50 tons of coal an hour at a prominent paper mill. Skip bucket has 60 cu. ft. capacity and a lift of 102 feet. It delivers coal to two cylindrical steel bunkers each having 100 ton capacity.

...provides a complete system for coal and ash handling

• Illustrated are two methods of handling ashes. The lower illustration shows ash hoppers with gates located below boiler room floor. Cars pick up the ashes, siftings and soot as they are discharged and dump into a skip hoist which delivers to an outside ash bunker.

The illustration at the upper right shows an outside tile ash bunker into which ashes are delivered by means of a conveyor and elevator. Trucks can then back under bunker and load. Both systems keep dirt out of the boiler room—both are equally efficient.





Above is shown an outside Fairfield ash bunker at a prominent enameling plant.

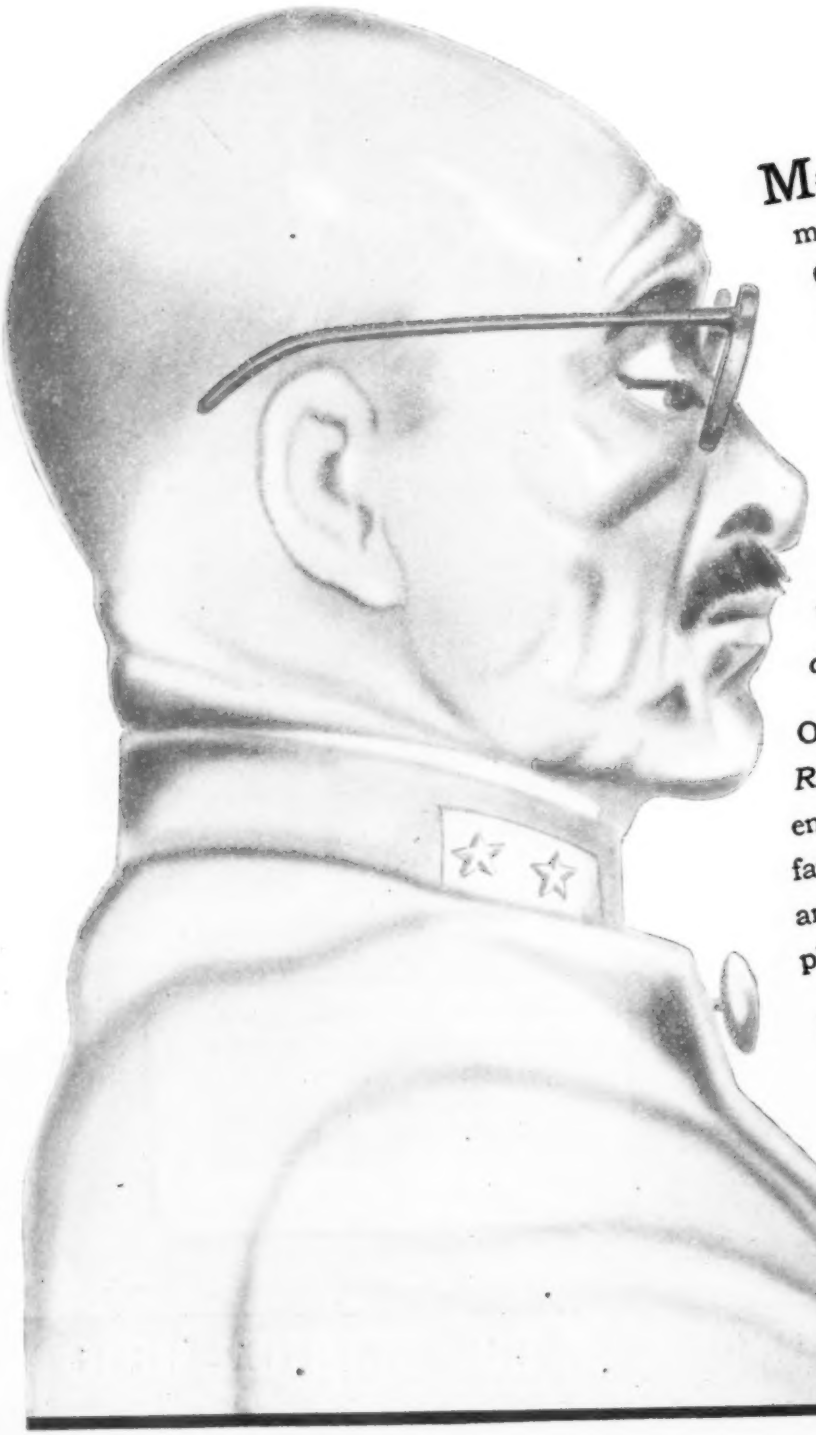
At the left are typical Fairfield Hoppers handling ashes, siftings and soot from 155,000 lb. boilers at a power station.

THE FAIRFIELD ENGINEERING CO.- MARION, OHIO

BUILDERS OF COAL AND ASH HANDLING EQUIPMENT

Then he said to himself

"VERY COMPLICATED, PLEASE"



Mild piece of understatement is that which Premier General Hideki Tojo made to his 83rd special session of the Japanese Diet:

*"The present war situation is very complicated. The enemy who was defeated at the beginning * * * is overcoming many difficulties and dangers."*

Of course, Tojo has read how *Recourse to Arc Welding* enabled us (his enemy) to fan out ships and planes and arms at spots which complicated his war situation.

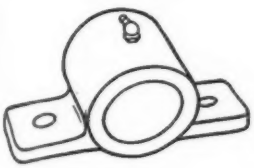
But perhaps he has not read of the mountains of little procedures, recourse to which overcame many difficulties and dangers for our production men.

"OVERCOMING DIFFICULTIES AND DANGERS"—he says

Look, Tojo: How having *Recourse to Arc Welding*, the production of war tools became *very simplified* for us . . . while their effect really made your position "VERY COMPLICATED."

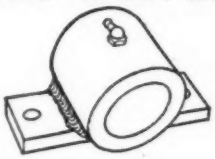
And think how in postwar they will make competition "Very Complicated" for a great many standpatters in production techniques.

VERY COMPLICATED, PLEASE



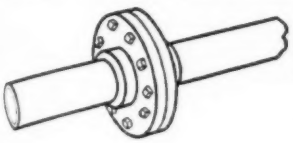
Drum shaft bearing . . .
Make pattern . . .
Mould . . .
Sand-blast . . .
(Cost in rough, $1.05)
Bore . . . Machine . . .
Drill holes.

VERY SIMPLIFIED, THANKS



Cut strap and drill holes . .
Saw piece of tubing . . .
Arc weld into unit. . . .
Total cost $0.50.

VERY COMPLICATED, PLEASE

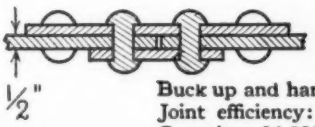


Connection in 10" steam pipe line . . .
Cut and thread ends of pipe . . .
Assemble with 2 flanges, gasket and set of bolts.
Joint requires maintenance.

VERY SIMPLIFIED, THANKS

Arc weld bevelled-end pipe . . .
A permanent, leak-proof joint.

VERY COMPLICATED, PLEASE



Structural joint requiring ½" plates . . .
Layout plates and straps accurately . . .
Drill holes accurately . . .
Put red-hot rivet in each hole . . .
Buck up and hammer down rivet heads . . .
Joint efficiency: 81.3%
Capacity: 24,390 lbs. per inch.

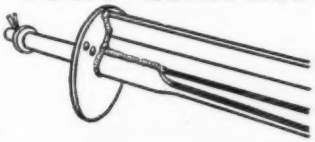
VERY SIMPLIFIED, THANKS

Only 7/16" plates required . . .
Bevel edge of plates . . .
Arc weld plates . . .
Joint efficiency: 100%
Capacity: 26,250 lbs. per inch.

VERY COMPLICATED, PLEASE

Axle for hay rake . . .
Make dies . . .
Forge parts . . .
Machine to fit . . .
Thread truss rod . . .
Assemble by bolting . . .
100% cost for loose-working assembly.

VERY SIMPLIFIED, THANKS



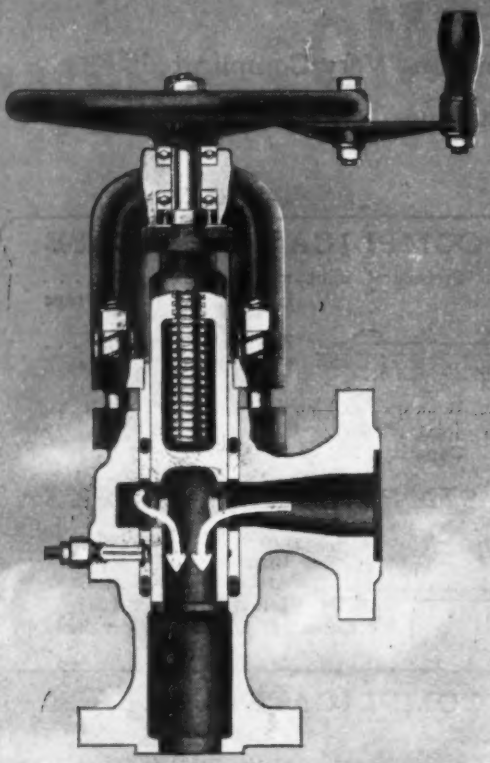
Cut angle, strap, bar and plate . . .
Arc weld into one unit . . .
70% cost for permanent assembly.

THE LINCOLN ELECTRIC COMPANY • CLEVELAND 1, OHIO

America's greatest natural **recourse**

ARC WELDING

Leading Institutions Select



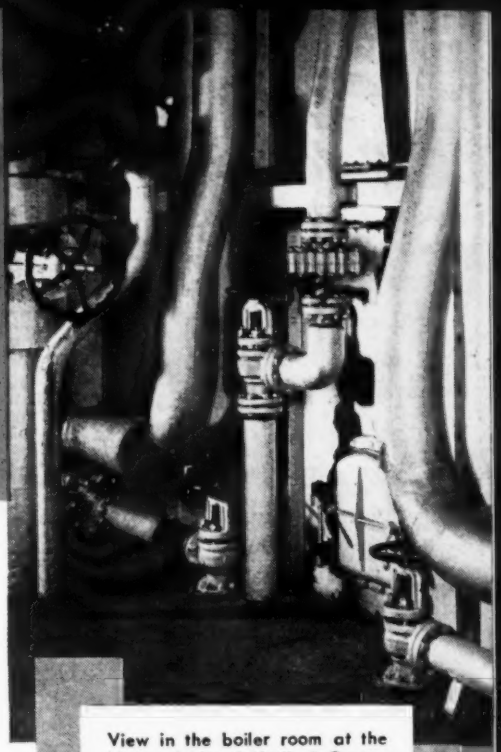
The Yarway Seatless Blow-Off Valve with no seat to score, wear and clog.

The recently completed National Naval Medical Center at Bethesda, Maryland, equipped with sixteen sets of Yarway Tandem Blow-Off Valves. Paul P. Cret, Consulting Architect.

YARWAY

Yarways

FOR TROUBLE-FREE BLOW-DOWN SERVICE



View in the boiler room at the National Naval Medical Center, Bethesda, Md., showing a few of the 32 Yarway Blow-Off Valves installed in this hospital.

Eighty Yarway Cylinder-Guided Expansion Joints also are in service on steam lines throughout this building.

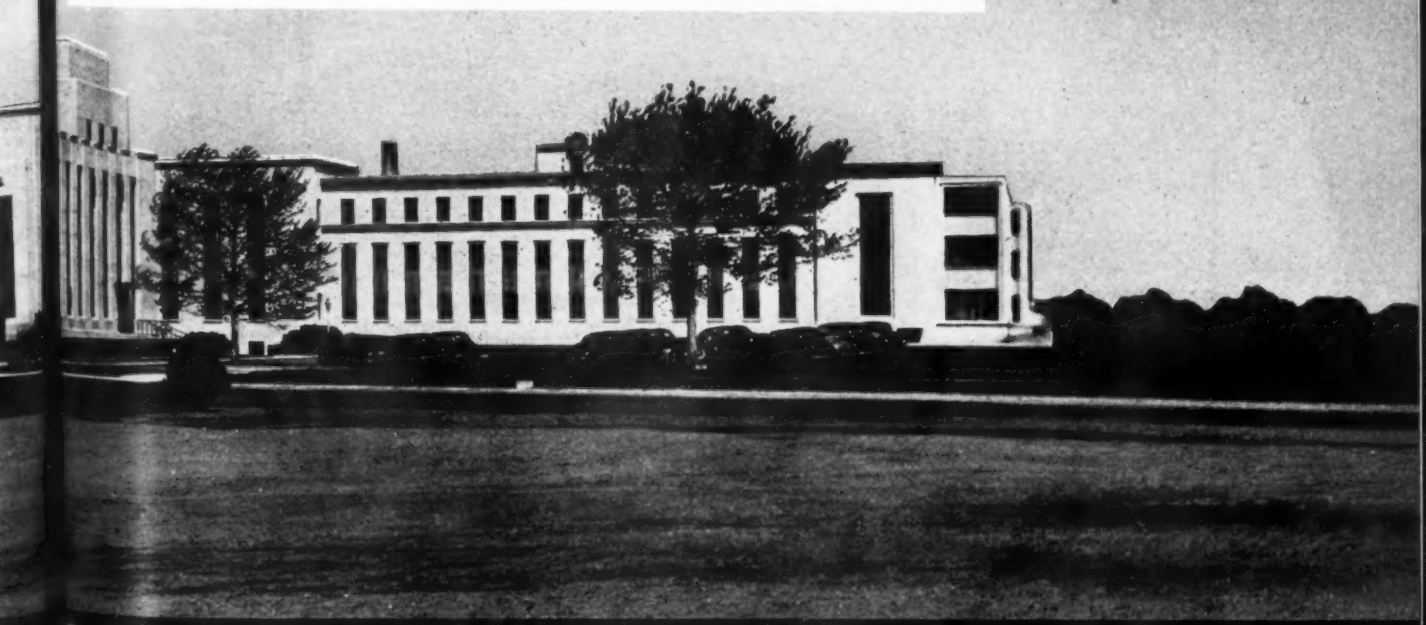
Where 100% dependability is paramount, as in hospital service, Yarway Blow-Off Valves are generally the choice.

At the 1,000-bed National Naval Medical Center, Bethesda, Maryland, sixteen sets of Yarway Tandem Blow-Off Valves are in use on the four boilers which heat this showplace of modern efficiency and architectural beauty.

The valve arrangement used is the popular favorite with many thousands of heating plants—the quick-opening, straight-through-flow Yarway Double-Tightening Valve in tandem with the positive-sealing, Yarway Seatless Valve, with no seat to score, wear and clog with mud, scale and dirt.

Whatever your blowing or draining and sealing requirements, there is a Yarway Valve combination designed expressly for that service. Write for Catalog; section B-422 for pressures up to 400 lb, section B-431 for pressures up to 2500 lb.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.



BLOW-OFF VALVES

Progress and Power in the

All the world knows the tremendous strides made by the Petroleum Industry since Pearl Harbor. Today this far reaching industry is playing a doubly important role in the production of high octane gasolines, lubricants, and other petroleum products . . . as well as in the fields of synthetic rubber and high explosives.

In these activities, American Blower has developed, especially for the Petroleum Industry, a variety of Elevated Temperature Fans for handling red hot gases.

At every step of oil production and refining, from the drilling of oil to the great Public Utilities which furnish the electric energy to the finished product, American Blower mechanical draft fans, blowers, and Fluid Drives are dependably performing important tasks.

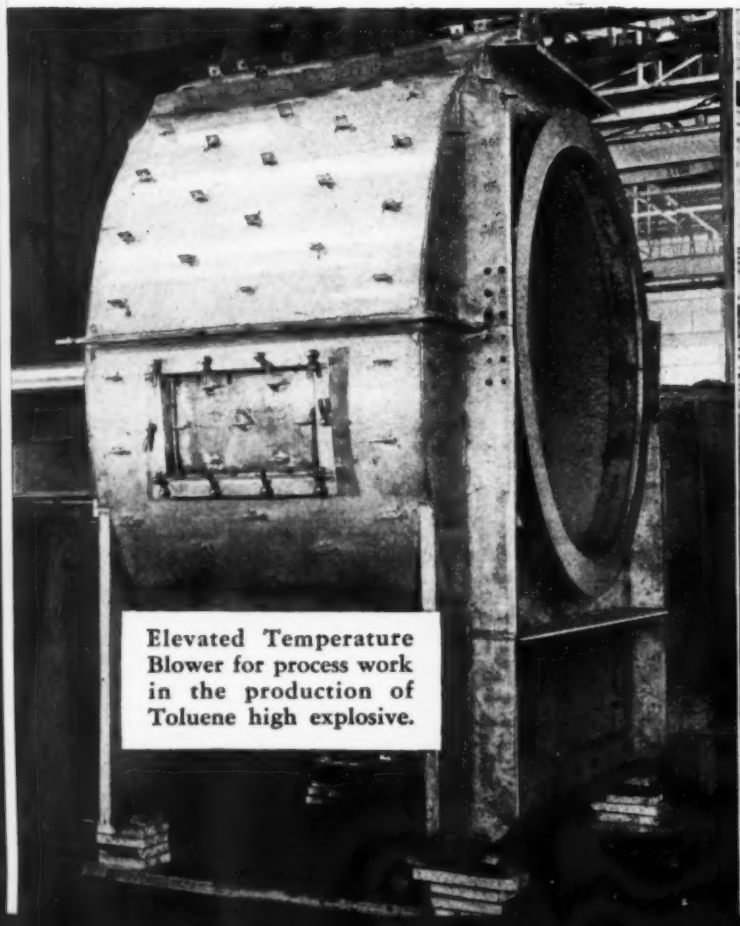
MECH. DRAFT · AIR-CONDITIONING · AMERICAN BLOWER · FLUID DRIVES · DUST COLLECTORS

AMERICAN BLOWER

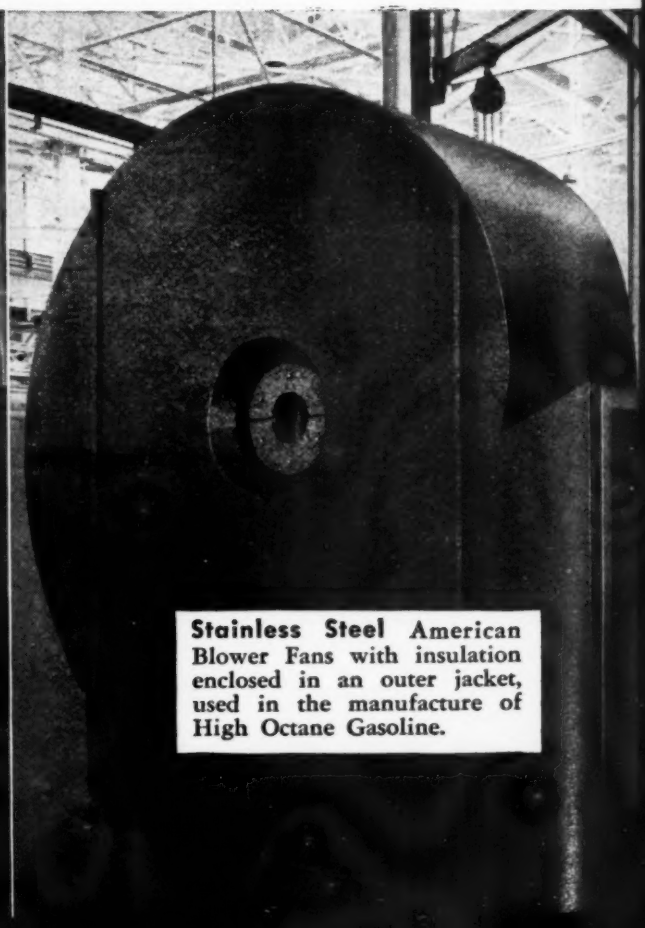
ARMY E NAVY
For excellence in production.

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

American Blower High Temperature Fan spec designed for circulating hot gases in the manu ture of Butadiene.

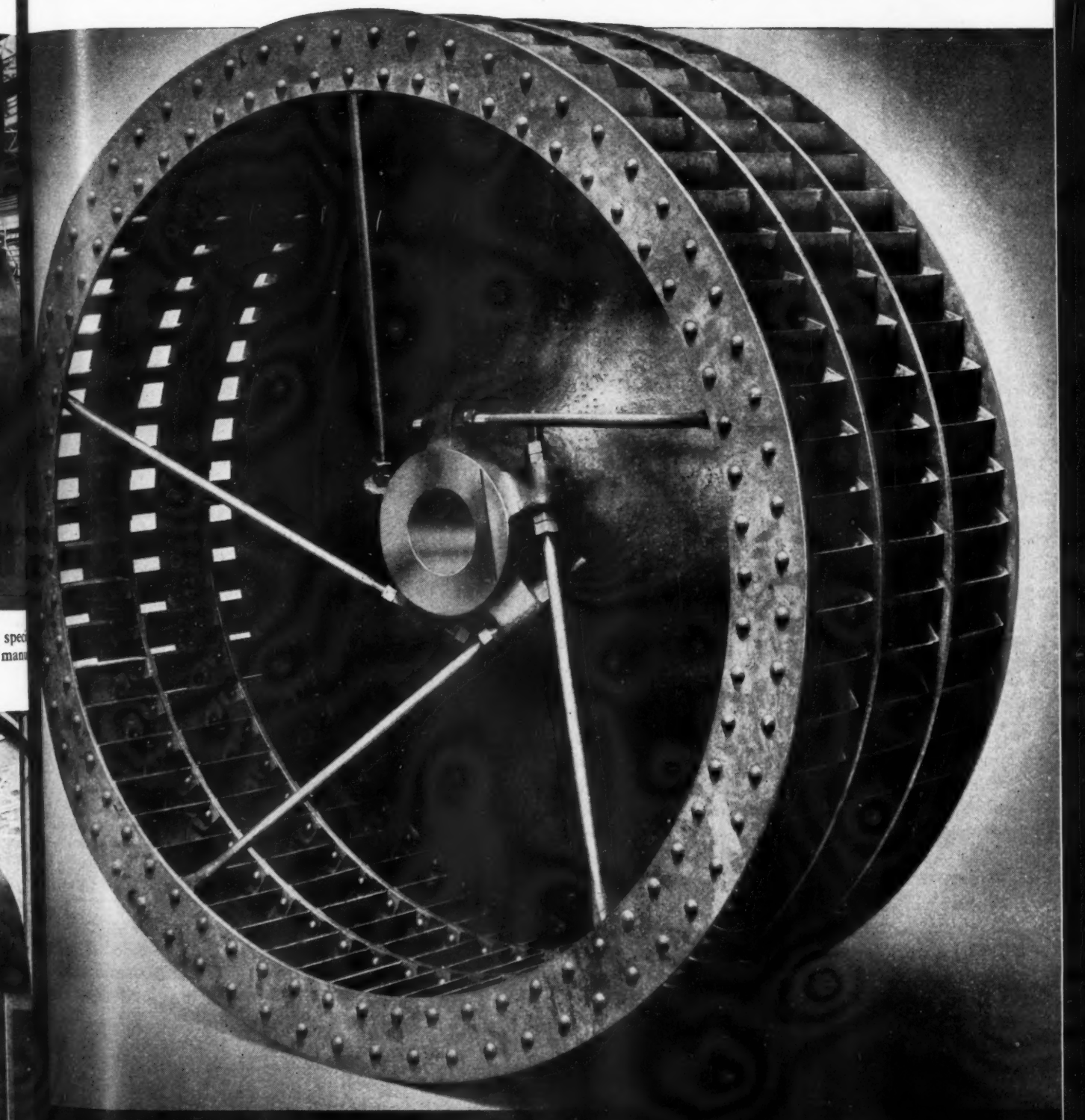


Elevated Temperature Blower for process work in the production of Toluene high explosive.



Stainless Steel American Blower Fans with insulation enclosed in an outer jacket, used in the manufacture of High Octane Gasoline.

PETROLEUM INDUSTRY



The wheel of an American Blower Heavy Duty Sirocco Elevated Temperature Fan constructed for maximum volumetric and power efficiency; also for *minimum distortion* and *internal stress*. Reliable wrought *stainless steel shapes* are used in the more highly stressed parts to provide maximum life against *metal creep*. This is the paramount criterion in the design of these *red hot* operating parts.

170 TONS COAL saved annually by 26 TRAPS

Manufacturer gets big return from small investment in Armstrong traps

FILE 394 We don't know how this particular manufacturer happened to get in touch with the Armstrong distributor in his town, but it could have been something like this:

"Hello . . . hello. Can you come over? We need your help on a steam line modernization job. Our three outdoor wood drying kilns don't heat well in cold weather, and the unit heaters don't work properly. The steam for the kilns and the heating system comes from the steam engine, and even with a back pressure of 7 to 10 lbs. the kilns take from 5 to 5½ hours to heat and at that the temperatures never exceed 110° F."

The Armstrong distributor found that the condensate drainage system, which allowed low pressure returns to blow direct to a closed receiver tank, was inefficient. Fuel consumption averaged 460 tons of coal a year. The distributor's survey indicated installation of 26 No. 200 and 211 Armstrong traps, individually draining unit heaters and providing positive drainage of drying kilns and steam engine.

KILN HEATING TIME CUT ½

The results were highly satisfactory. Back pressure on the steam engine dropped to 3 lbs. and later to 2 lbs. The kilns now require only 2 to 2½ hours to heat, and a temperature of 150° was maintained even on the coldest days. Coal consumption was cut from 460 to 2[illegible] tons a year, representing a saving of 37% on fuel alone.

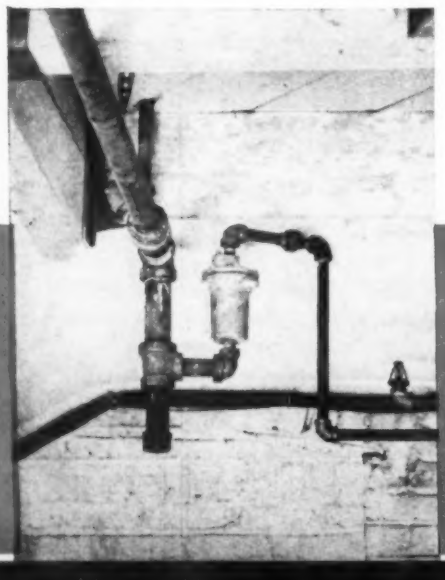


TABLE OF SAVINGS

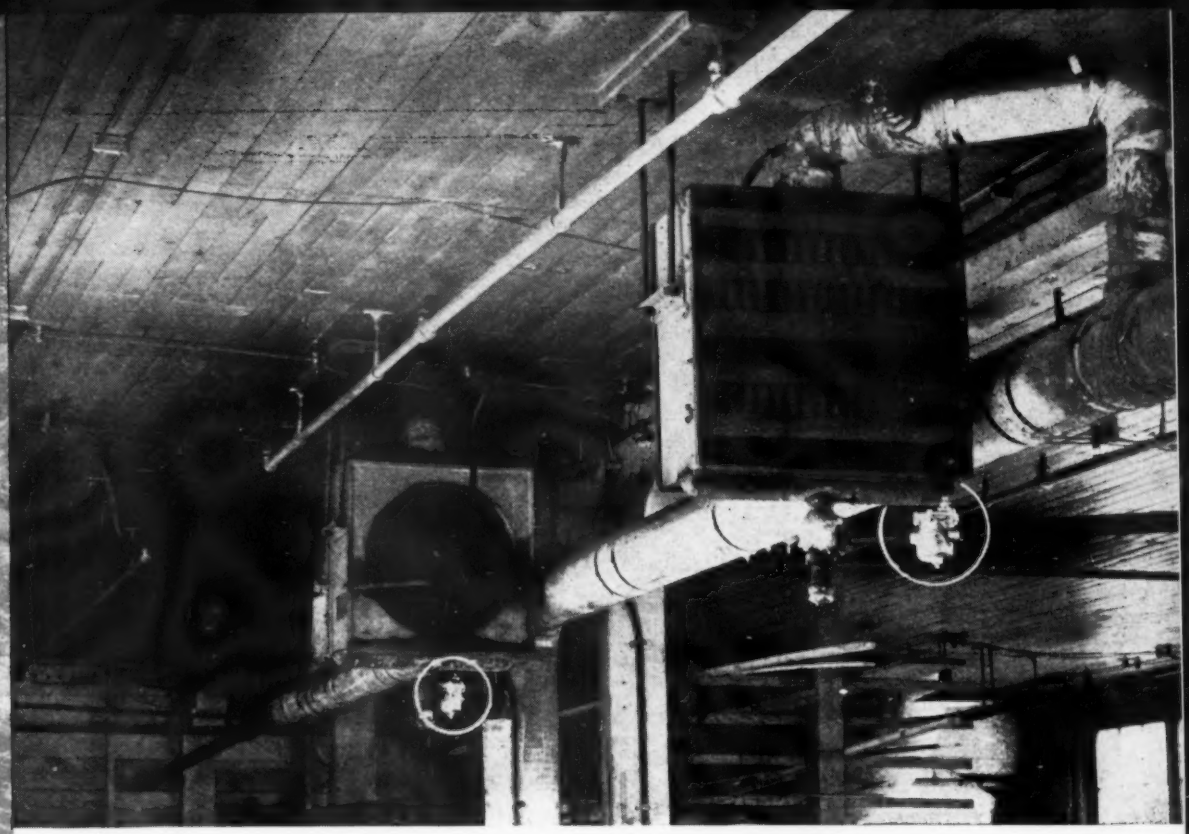
Fuel loss of various size steam leaks at 100 lbs. steam pressure

Orifice size	Lbs. steam lost monthly	Coal waste per year	Oil waste per year
1/2"	835,000	334 tons	53,440 gal.
3/8"	470,000	188	30,080
1/4"	210,000	84	13,440
1/8"	52,500	21	3,360
1/16"	13,200	5.3	848
1/32"	3,400	1.4	224

The above table is based on evaporation of 15 lbs. of water per lb. of coal, and that 160 gallons of oil are equivalent to a ton of coal.

OTHER SAVINGS EXAMPLES

A fish cannery in British Columbia saved $250 a season on fuel after the installation of four Armstrong traps on steam heated settling tanks. A fibre-board manufacturer reduced heating time on corrugating and pasting machines 20% by installing 30 Armstrong traps to drain heating plates individually. A chemical company saved $2500 a year in fuel [illegible] the installation of 16 Armstrong traps. These are but a few of the great many instances of savings in fuel, in heating time, in manhour[illegible] in boiler capacity and in maintenance effected by Armstrong inverted bucket steam traps.

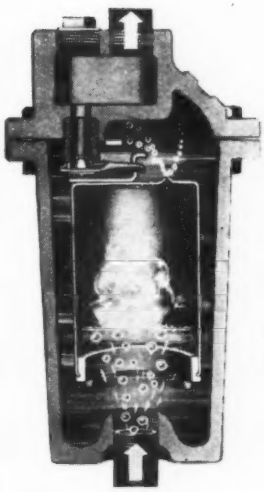


Complete trapping gets results in all steam-using industries

The difference in fuel and heating time savings between Armstrong *complete* trapping and condensate drainage by ordinary methods is often enough to pay the cost of Armstrong traps in a short time.

Cracking a valve drains condensate but may waste a lot of steam. (A 1/16" orifice at 100 lbs. pressure wastes 13,200 lbs. of steam a month, equivalent to 5.3 tons of coal or 848 gallons of fuel oil a year.) Devices actuated by liquid level cannot draw off air. (½ of 1% of air mixed with steam can reduce heat transfer efficiency 50% according to one authority.) Heat actuated devices have to hold the condensate back until it cools below steam temperature to prevent loss of steam. Continuous flow devices either obtain poor drainage at heavy loads, or use larger openings and lose steam on light loads.

By complete trapping we mean the ability of Armstrong inverted bucket traps to eliminate air . . . pass dirt, sludge and scale ordinarily encountered in steam lines . . . prevent steam loss . . . as well as drain condensate automatically as fast as it forms.



Above: Armstrong bottom inlet-top outlet trap with bucket in closed position.

Side inlet-bottom outlet trap.

Side inlet-side outlet trap.

PATENTED FREE-FLOATING VALVE

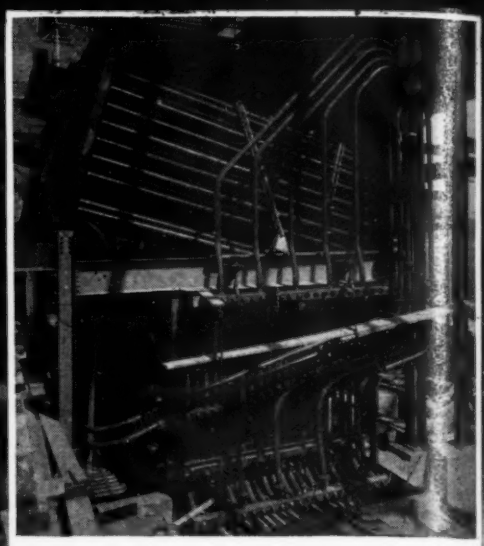
The frictionless leverage system and other engineering features of Armstrong traps insure freedom from wire-drawing of the valve and orifice, permit holding tight against vacuum, and insure long life with negligible maintenance. Considering their capacity with hot condensate, Armstrong traps are very small in size and low in cost. The Armstrong Trap Book illustrates standard and special traps, and contains valuable data on trap selection and installation. We'll be glad to send you a copy.

ARMSTRONG MACHINE WORKS
812 Maple St. • Three Rivers, Mich.

ARMSTRONG · INVERTED BUCKET · STEAM TRAP

Armstrong

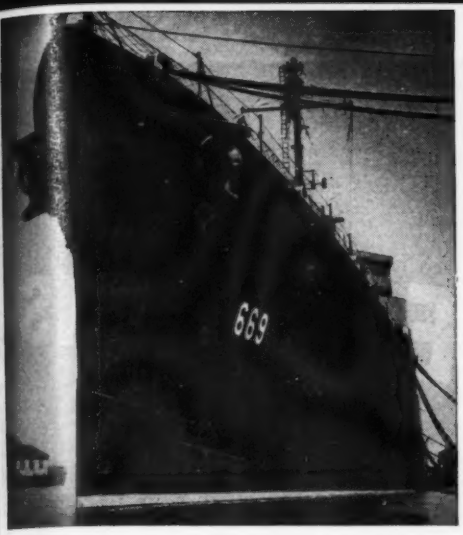
STEAM TRAPS • AIR TRAPS • PURGERS • HUMIDIFIERS



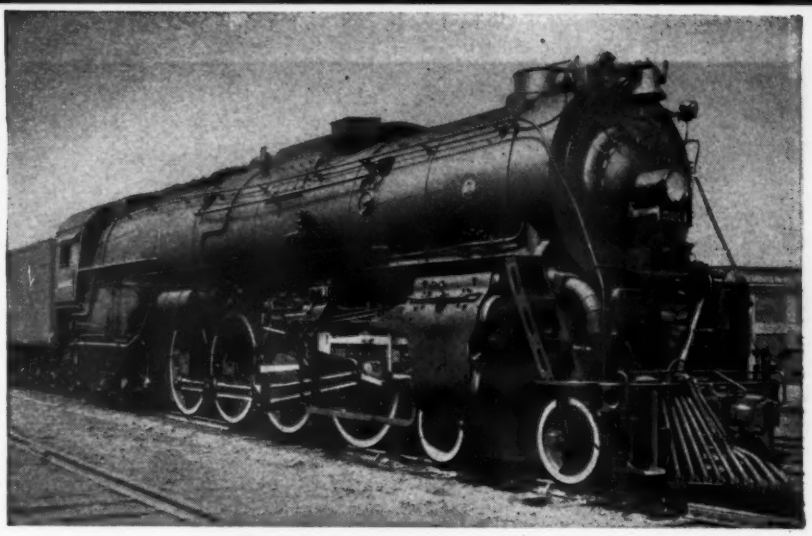
Two 1000-hp. Box Header type boilers built with NATIONAL Seamless Boiler Tubes. Now in continuous operation under peak war loads.

You, too, will be glad

Layout Floor at a NATIONAL boiler tube plant. Full scale diagrams are used to make absolutely certain that boiler tubes fit when they are assembled in the field.



Red-hot boilers. NATIONAL Seamless Tubes on new U. S. destroyers must be able to operate at a cherry-red without failure. This puts a terrific strain on the tubes but it enables a destroyer to get up steam in a fraction of the time formerly required.



551,388 miles per set of National Seamless Boiler Tubes. That's the amazing average set by 11 locomotives running from San Francisco to Kansas City, Mo. One engine rolled up a total of 695,118 miles before tubes were changed.

...d you used Seamless Boiler Tubes

THE war has forced boiler tube users to get the maximum possible service out of every tube. Durability has become the prime factor, with safe operation under overloads running a close second. Important, too, is the ability of a tube to withstand manipulation punishment both in original installation and subsequent resetting of the tubes. Here's how Seamless is standing up under war conditions:

More and more reports are coming in which show NATIONAL Seamless Tubes are giving up to double the life of non-seamless tubes. This is due chiefly to three factors—higher grade steel to begin with, no welds, and uniform wall strength throughout.

Other reports emphasize that when boiler equipment is fabricated from seamless tubes, all uncertainty about its tubes is removed, that there need be no fear that under the rigors of modern conditions some slight, discontinuity in a weld will provide the starting point for a disastrous failure.

Still other Master Boiler Makers report that NATIONAL Seamless Tubes can be more readily bent, expanded, flanged, beaded, and rolled tightly into headers without splitting or fracture. They say these are practical qualities that boiler makers always appreciate.

When conditions ease up and more boiler tubes become available, remember the experience of these seamless users and why they are glad they used Seamless.

Steel needs scrap NOW . . . . send it in!

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

NATIONAL SEAMLESS

USS

UNITED STATES STEEL

fireye Prevents Explosions

TYPE F28C

GUARDS AGAINST FLAME FAILURE PHOTOELECTRICALLY

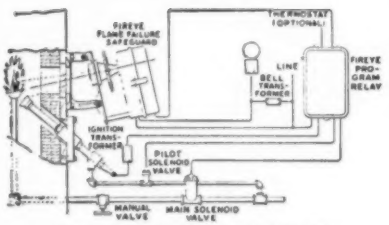
Monitors oil, gas, pulverized coal burners *electronically*. Instantly detects flame failure, cuts off fuel supply.

Controls Every Flame—positively observes even blue transparent gas pilot flame—is the *only* photoelectric safeguard sufficiently sensitive for use with all fuels and for monitoring pilot, main flame, or both.

Acts Instantly, Dependably—is the only control that detects flame failure entirely by direct observation of the flame itself. All other control methods rely wholly or partly on temperature, electrical conductivity or other indirect and, therefore, less positive flame characteristics.

Provides Completely Automatic Control—is used alone for control of manually ignited burners, to turn off both main and pilot valves and sound an alarm; or, when burner is automatically fired with Program Relay Type R25, to provide desired sequence of fuel pump and valve operation.

For complete information, write today for Catalog 50



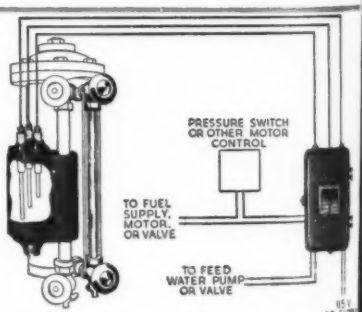
TYPICAL FIREYE INSTALLATION FOR AUTOMATICALLY IGNITED OIL BURNER

fireye BOILER FEEDWATER CONTROL

Floatless . . . Maintenance-Free . . . Electronic

- Maintains Desired Water Level Automatically.
- Instantly Cuts Off Fuel Supply and Sounds Alarm at Low-Water Danger Point.
- Fireye Boiler Feedwater Control operates electronically, contains no moving parts to wear out or fail in operation, is simple to install—at last makes available to the average power plant completely automatic control—at low cost.

Write today for Catalog 51


PRESSURE SWITCH OR OTHER MOTOR CONTROL
TO FUEL SUPPLY, MOTOR, OR VALVE
TO FEED WATER PUMP OR VALVE
Probe Fitting
Electronic Cont

Typical FIREYE Installation For Automatic Boiler Feedwater Control And Low-Level Safeguard

fireye

COMBUSTION CONTROL CORPORATION

77 Broadway, Cambridge 42, Massachusetts

DISTRICT OFFICES IN ALL PRINCIPAL CITIES

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make SHAFTS Last Longer . . .

The Allis-Chalmers "Electrifugal" Pump is a unit-designed pump . . . with both impeller and motor mounted on one shaft and in one frame. The next time you need new pumps . . . look into the extra efficiency, ruggedness and long life of Allis-Chalmers centrifugal pumps . . . the "Electrifugal" . . . and all types for every purpose.

WHERE YOU HAVE an Allis-Chalmers "Electrifugal" Pump . . . shaft and rotor pictured at left . . . you don't have an alignment problem—because *both* impeller and rotor are mounted on *one* shaft.

However, many pumps in use today are coupled to a separate motor, and how well the two are aligned has a lot to do with how long the shaft lasts . . . and the pump and coupling too . . . because misalignment starts all three fighting each other!

Here are a few tips which will help you get longer life out of pump shafts:

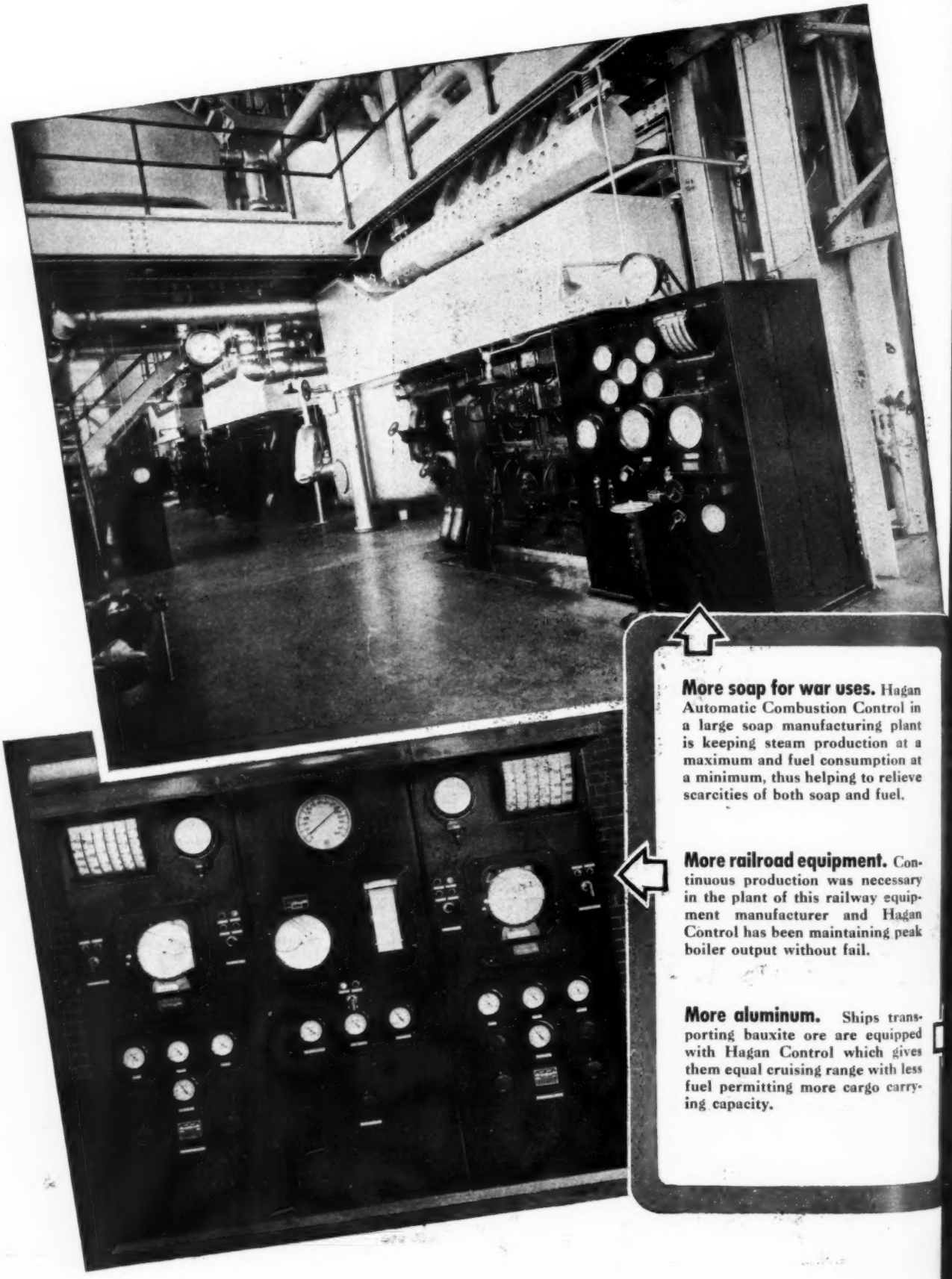
- See that pump and motor coupling flanges are parallel . . . both vertically and axially . . . and that they are kept that way!
- If misalignment recurs frequently, check foundations, piping, bolted connections.
- In the case of boiler feed or other pumps which reach high operating temperatures, be sure that alignment of motor and pump is checked after *both* have been operating. Otherwise they might develop misalignment from unequal expansion.
- If you haven't done so already, send for your *free* copy of "Handbook for Wartime Care of Centrifugal Pumps". Contains *no* advertising. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WISCONSIN. A 1707

Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.

How much would you take



More soap for war uses. Hagan Automatic Combustion Control in a large soap manufacturing plant is keeping steam production at a maximum and fuel consumption at a minimum, thus helping to relieve scarcities of both soap and fuel.

More railroad equipment. Continuous production was necessary in the plant of this railway equipment manufacturer and Hagan Control has been maintaining peak boiler output without fail.

More aluminum. Ships transporting bauxite ore are equipped with Hagan Control which gives them equal cruising range with less fuel permitting more cargo carrying capacity.

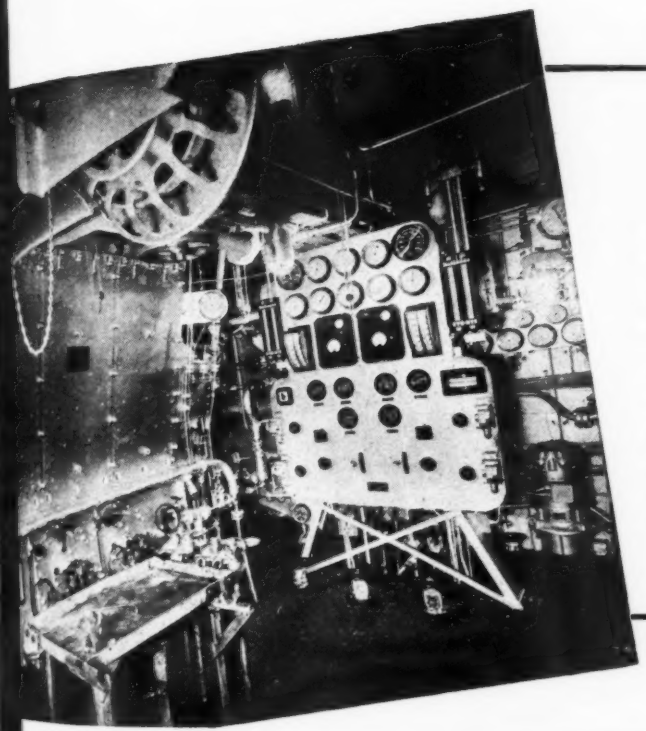
for your Hagan Control ?

WE might just as well ask you how much you would take for your right arm. For today, the value of automatic combustion control cannot be measured in dollars alone. Any war plant operator knows how well it has enabled him to meet the man-power problem, the fuel shortage and the demand for every possible pound of steam. He looks, also, to the long-range investment . . . the years of trouble-free service it will give.

Because of the remarkable simplicity of its operation, the sturdy way in which it is built, the exclusive Hagan features which set it in a class by itself, Hagan Control accomplishes these results with a minimum of time, attention and trouble.

If you need automatic combustion control we can help you.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.



HAGAN CONTROL ASSURES

MAXIMUM QUANTITY of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.

MAXIMUM UTILIZATION value, uniform steam pressure and temperature, in accordance with demand.

MAXIMUM OUTPUT from boilers of differing capacities, automatically.

MAXIMUM STEAM for production, by reducing loss of steam in frequent soot-blowing.

MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

HAGAN
HALL
BUROMIN
CALGON

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

ACTION AND REACTION MUST BE EQUAL AND OPPOSIT

FORCE BALANCE

PRINCIPLE OF MEASUREMENT AND CONTROL

Recent developments in the application of the Force Balance principle offer some interesting and unique possibilities for the automatic regulation and measurement of flow—pressure—liquid level and temperature in your plant. Write us for details.

REPUBLIC
INSTRUMENTS
AND CONTROLS

The Smoot Engineering Corp., now a part of the Republic Flow Meters Co., were early pioneers in the application of the Force Balance principle to automatic metering and control equipment. The first Smoot regulators built in 1914 incorporated the Force Balance principle as have all Smoot (now Republic) regulators since that time. It is the recent developments in the application of this old principle that are establishing new standards of accuracy and sensitivity in the field of measurement and control.

★

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago 47, Illinois

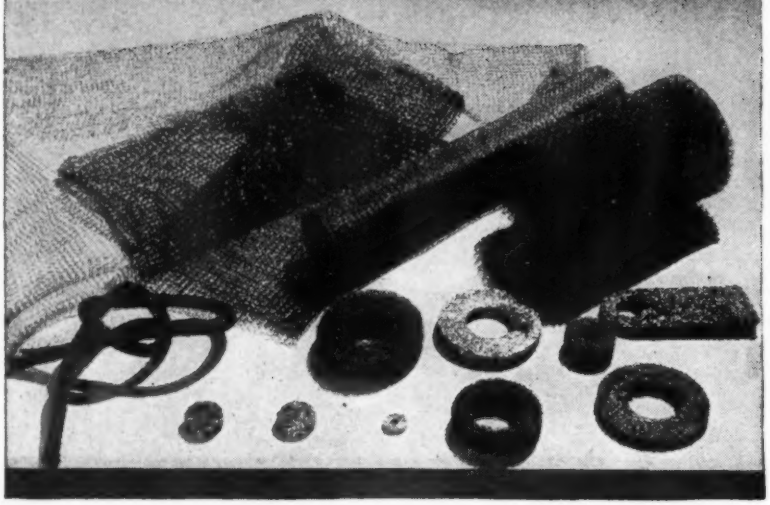
"I want A FLEXIBLE GASKET TO WITHSTAND 2000° F." said the airplane part maker

"I want A FEEDWATER CLEANER THAT CORROSION WON'T CRIPPLE" said the railway mechanical engineer

"I want A FINE TUBE GRID THAT WON'T SAG" said the electronic tube maker

"I want A LASTING WICK FOR AIRPLANE HEATERS" said the cabin heater maker

All found their answer in KNIT METAL MESH



Knit metal mesh has provided the answer to a lot of tough problems. Perhaps it's the answer to one of *your* problems, too.

The special *linked loop* design assures flexibility, high resistance to breakage, and bias strength.

The fabric holds together even when made of very fine wire (.0045" diameter) and with as few as 4 or 5 openings to the inch. It can be compressed lightly for air, liquid or gas filters... tightly for gaskets.

In applications requiring extra strength, toughness, resistance to high temperatures, corrosion resistance, and other specialized properties, INCO Nickel Alloys are used.

Thus, Inconel knit mesh is used for airplane exhaust manifold gaskets that must retain flexible strength at 1500° F., and for capillary wicks in airplane cabin heating units. Pure Nickel is used in a design that prevents sagging of fine mesh electronic tube grids.

Rustless, corrosion-resistant knit Monel pads are used to filter grit and scale from locomotive feedwater before it is pumped back into the boiler. The Monel mesh made from .006" wire, permits free flow of the water as there is 96% free space... 15,000 square inches of filtering area in a 14" x 20" pad. The pads are readily cleaned every four or five weeks in Oakite and Soda Ash Solution.

For further information, write direct to Metal Textile Corporation, Orange, N. J., makers of knit metal mesh, or to: The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

"I want A BETTER AIR FILTER MEDIUM" said the filter manufacture

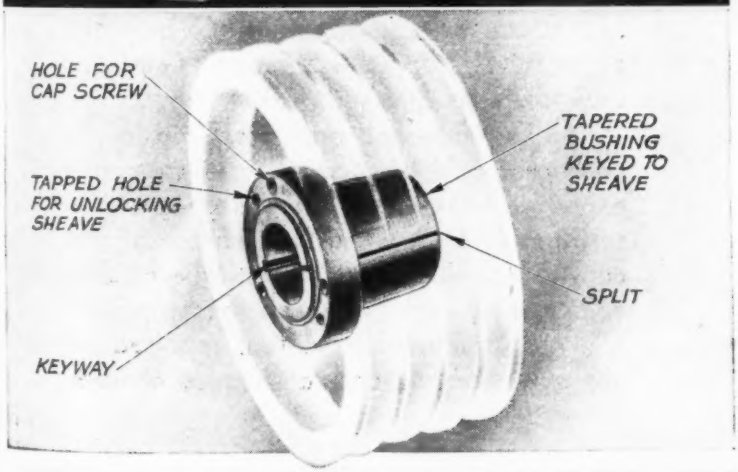
"I want A FLEXIBLE STRAP THAT WON'T JIGGLE LOOSE" said the magneto maker

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • *Sheet... Strip... Rod... Tubing... Wire... Castings*

It saves you Man-hours and Money because it "Grips like Magic!"

Mounting and removing of "Magic-Grip" sheaves are quick and easy operations because... tapered split bushing accommodates normal shaft tolerances.



Allis-Chalmers' new "Magic-Grip" Sheave locks to shaft in one easy operation, mounts faster than any other sheave on the market. It helps conserve your motors and machines, too!

THE sheave that "grips like magic" is kind to both shafts and bearings. Its positive clamp fit allows sheave to be changed as often as desired without injury to shaft or itself. And the new design of "Magic-Grip" permits sheave to be mounted closer to motor... increasing bearing life by reducing shaft overhang.

You get smoother running performance, too, because the new "Magic-Grip" sheave is perfectly centered when installed on shaft.

Allis-Chalmers "Magic-Grip" is assembled and mounted as a unit, assuring true alignment. Its split-bushing feature allows for over- or undersized shafts... making it possible for *anyone* to mount or demount sheave easily.

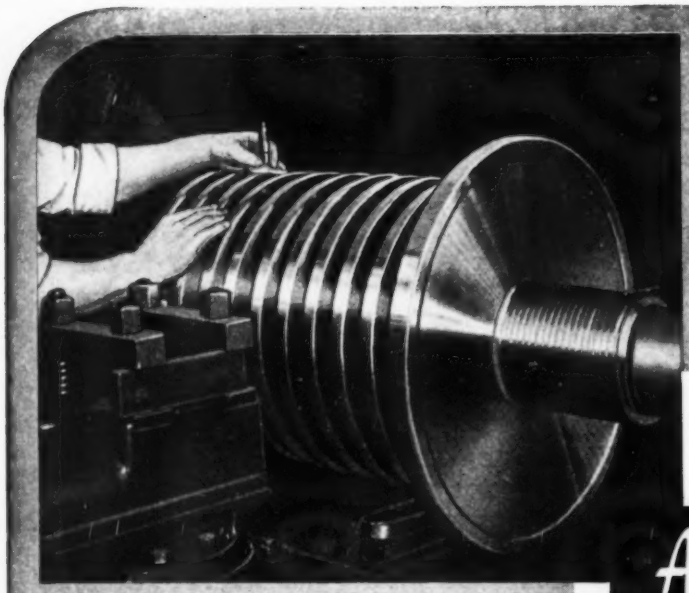
And you get all these advantages at *no increase in price.* Now, more than ever, it pays to make Allis-Chalmers your "V-Belt Drive Headquarters."

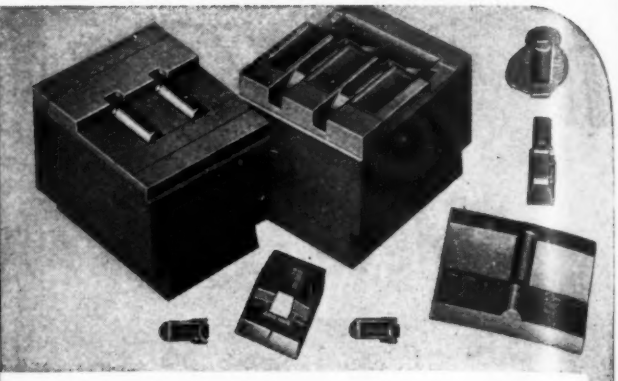
"Magic-Grip" sheaves are stocked in a complete line. For full data, ask our district office or dealer for B6310. Or write ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1683

Allis-Chalmers Texrope

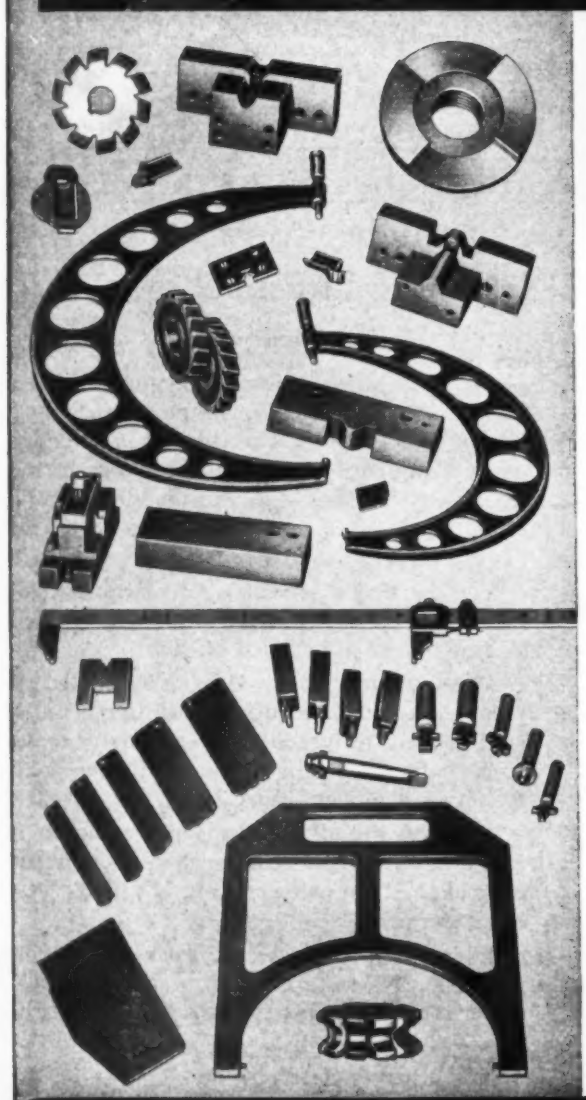
"MAGIC-GRIP" SHEAVES





Special tools, gages, jigs and templates used in the production of the integral steam turbine rotor shown.

A Manufacturing Policy THAT HAS STOOD THE TEST OF TIME



From its inception in 1901, the De Laval Steam Turbine Company has recognized that the best results are obtainable only by confining the work of its staff to the development, design and production of a single class of manufacture, having the same general characteristics and requiring the same processes and high grade of workmanship. Consequently the efforts of the company have been confined to high-speed rotary power equipment, including STEAM TURBINES, HELICAL and WORM SPEED REDUCING GEARS, CENTRIFUGAL PUMPS and COMPRESSORS and ROTARY OIL PUMPS.

The jigs, tools and gages required for the production of high-grade work are much more expensive and elaborate than are those necessary for work requiring less refinement and care in manufacture. Also, the type of shop employee who can perform this accurate work is entirely different from that required for less particular and accurate classes of work.

M-29

De Laval STEAM TURBINE CO.
TRENTON 2, N.J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS, WORM, HELICAL; and FLEXIBLE COUPLINGS

MARCH
1944

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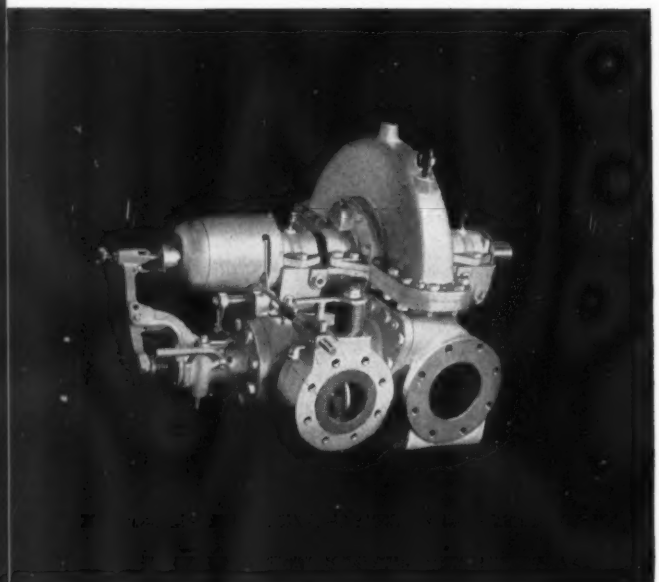

Type C-14 Single-stage General-purpose Turbine. Built for service at 5 to approximately 200 hp; speed range 1000-5000 rpm. Suitable for use with steam pressures through 600 lbs. gauge, and for total temperatures through 750° F.

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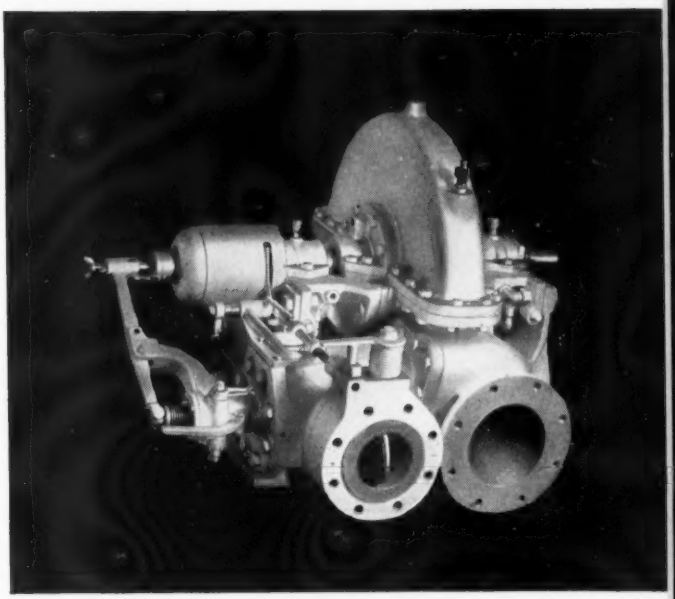
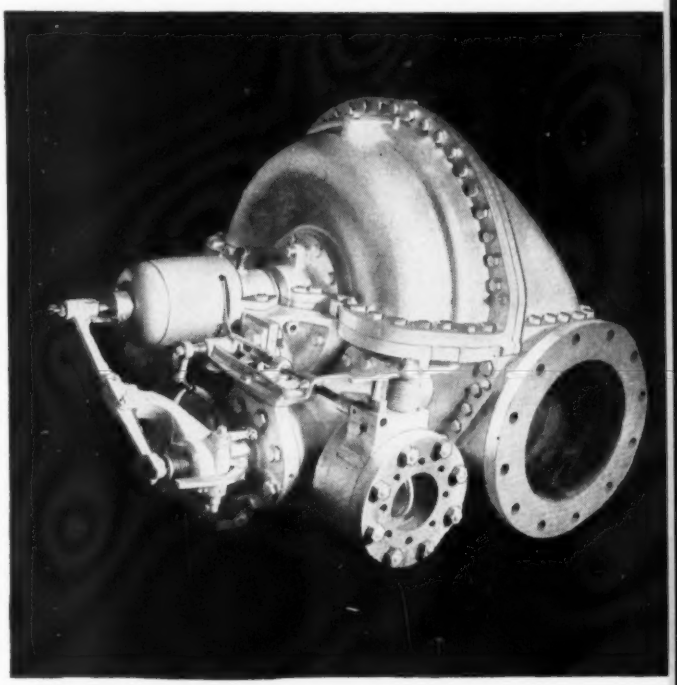


Type C-225 Two-stage General-purpose Turbine. Built for services through approximately 1500 hp; speed range 1000-5000 rpm. Suitable for use with steam pressures through 600 lbs. gauge, and for total temperatures through 750° F.



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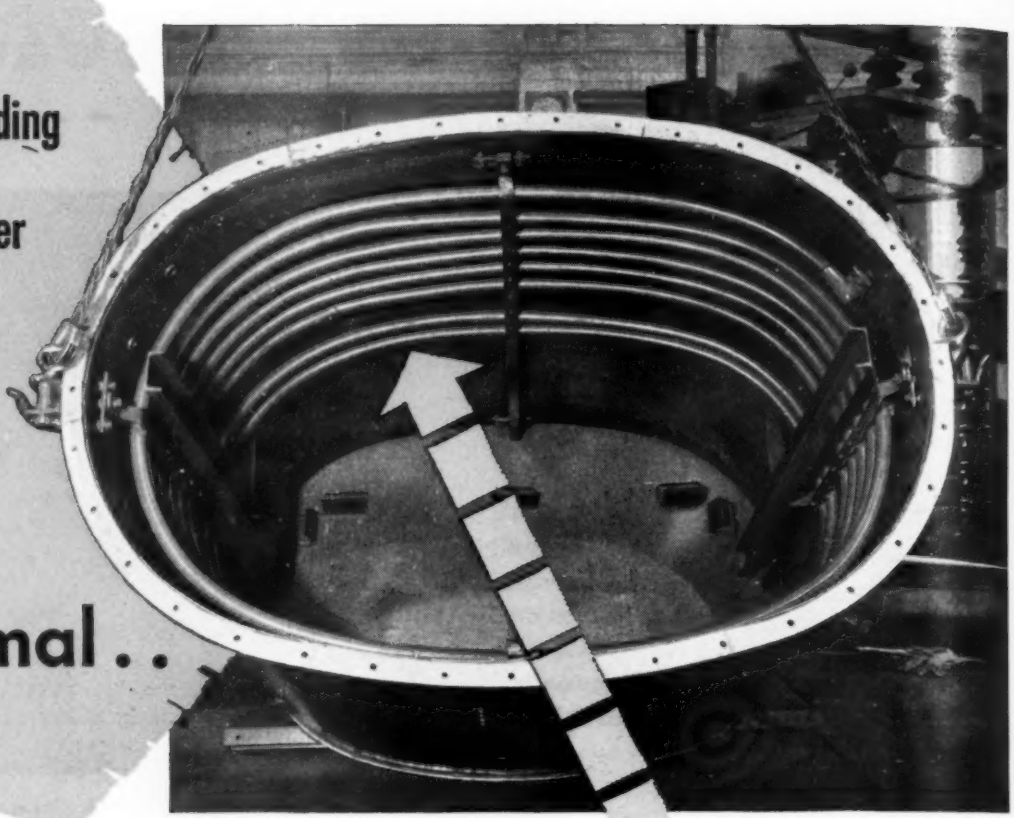
Holding Transformer Temperatures down to normal . .



Another job for BYERS WROUGHT IRON

All electrical equipment made today faces the prospect of sustained full-load or over-load operation . . . so the cooling system that keeps transformers from "running a fever" has a highly responsible job.

When the availability and delivery situation necessitated a change in material specifications for the cooling coils, the engineers at the Pennsylvania Transformer Company made a careful investigation, including tests of welding and bending qualities, and chose wrought iron. A photo of one of the wrought iron elliptical coils installed is shown above. Box coils, with 90° bends on the corners, are also being produced.

The life expectancy of the transformers is 25 years, so that the corrosion-resisting qualities of wrought iron are highly important. As generally happens with wrought iron, past experience provided a sound basis for selection. The material is utilized for transformer cases installed in corrosive atmospheres, and for external radiation coils. And when its use in heat-exchanger applications is considered, the available records mount into the hundreds and cover periods of up to half a century.

The qualities of wrought iron which recommend it for this new service come directly from its unusual composition. Wrought iron is composed of a high-purity iron base, threaded with tiny fibers of glass-like silica slag. The network of fibers diffuses and spreads corrosive attack, avoiding the pitting and penetration that generally causes ordinary materials to fail. Then, too, the fibers anchor the initial protective film firmly in place, shielding the underlying metal.

As time goes on, engineers are finding more and more important uses for wrought iron in the electrical field. The present list includes heavy-wall conduit, motor frames, yokes for aircraft amplidynes, lightning masts, precipitator plates, salt annealing furnace electrodes, switch and junction boxes, generator housings and bus bars. There may be some unsuspected places where wrought iron could serve you, and a review of some of the places where it is serving others is an excellent way to find out. Our technical bulletin, "101 Uses for Wrought Iron" pictures and describes a number of various applications. May we send you a complimentary copy?

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POWER

PHILIP W SWAIN, EDITOR • MARCH 1944 • ESTABLISHED IN 1882

Let's Fight for Clean Air

NEVER BEFORE in this generation have the skies over industrial America been so dark, the sun so dim, or the air so thick. To some, smoke spells production, but this vast smudge from ten thousand stacks won't speed the defeat of Germany or Japan. Instead it injures morale, impairs the health of war workers, damages property and product, overloads laundries and wastes coal.

True, the war caught us unprepared for clean stacks, so we must suffer a little longer for past neglect. Just the same, there's a warning written in that smoky sky. It says that American towns and cities can't stay this way after the boys get home.

The incredible evils of smoke are a challenge to our common sense—they mean widespread sinus and lung troubles; damage to throats and eyes; sunshine starvation; dirty buildings, streets and faces; corrosive deposits on metal structures and monuments, even on library books. Is it safe to assume that postwar America will tolerate this vast destruction of human values and property?

Now here's the practical point: Let forward-looking power engineers give every postwar modernization plan the clean-stack test. Are projected furnaces and firing equipment good enough and big enough to carry the peaks without smoke? Will they stay smoke free *with any available coal?* If not, the plant will be obsolete the day it starts operation.

No matter how you figure it, the smokeless plant is the only safe plant to own—and by far the cheapest to run. It burns fewer tons of less costly coal. It builds public good will, and protects buildings, machines and products. Above all, it guards the health of the community, even the lives of its citizens.

As far as any man can be, the power engineer is the giver of life to his community through his generation of power to vitalize its industry and transportation. Some day he will free this gift of the taint of destructive smoke.

From Sewage-Disposal Digester Gas Come POWER and HEAT for Plant Operation

▶A MODERN activated-sludge sewage-treatment plant is in reality six plants —all combined into a continuous process: pumping, air compressing, sewage treatment, gas producing, power generating and heating. Representative of the latest development in such works is New York City's Bowery Bay, at Astoria, Long Island, with 40-mgd treating capacity. Two 800-hp gas engines, with space for two more, are among its interesting features.

Before describing the power, pumping, air-compressing and heating equipment, let's look briefly at the treatment system. Fig. 2 shows diagrammatically the principal features of such a plant. Raw sewage from the sewage system comes into the screen chamber through hydraulically operated gates that close automatically to prevent flooding of the screen house during periods of excessively high flow into the sewers. The sewage passes through coarse racks to remove larger solids, such as tin cans, bed springs, Christmas trees, wood blocks, baby carriages, and the like. Fine racks remove other material that might stick in the pumps. After grinding, the fine rackings are returned to the raw sewage which contains 0.05%, or less, of solids.

Sewage Flow

Large pumps discharge screened sewage to the grit chamber, where it passes through at about 1 ft per sec. Here sand, cinders, ashes and other hard material settle out, but the organic solids are carried into the preliminary settling tanks. In these tanks about 50% of the remaining solids settle before the effluent goes to the aeration tanks where it is subjected to biological treatment, known as an activated-sludge process. Organisms inherent to this process multiply rapidly in the presence of oxygen, supplied by compressed air forced through porous plates in the bottom of the aeration tanks.

From the aeration tanks, sewage goes to the final settling tanks. Major part of the solids settling out in these tanks is returned to the aeration tanks to provide activated sludge. Liquid leaving the final settling tank is sparkling clear and in proper condition to discharge to a river or other water course.

Grit, removed mechanically from the grit chamber, is washed by effluent from the final settling tanks and hauled away for fill. Sludge settling out in the preliminary and part of the sludge from the final settling tanks is removed mechanically and pumped to the digester tanks. Here, under the influence of an 85-F temperature and the action of anaerobic (able to live in absence of free oxygen) bacteria, it is reduced to an innocuous humusy material. This digested sludge is similar to swamp soil for lawns and gardens and may be used as a soil conditioner.

From the digester process, gas is obtained having a normal heat content of about 640 Btu per cu ft. This gas, approximating 64% methane, 33% CO_2 and 3% of other gases is used for

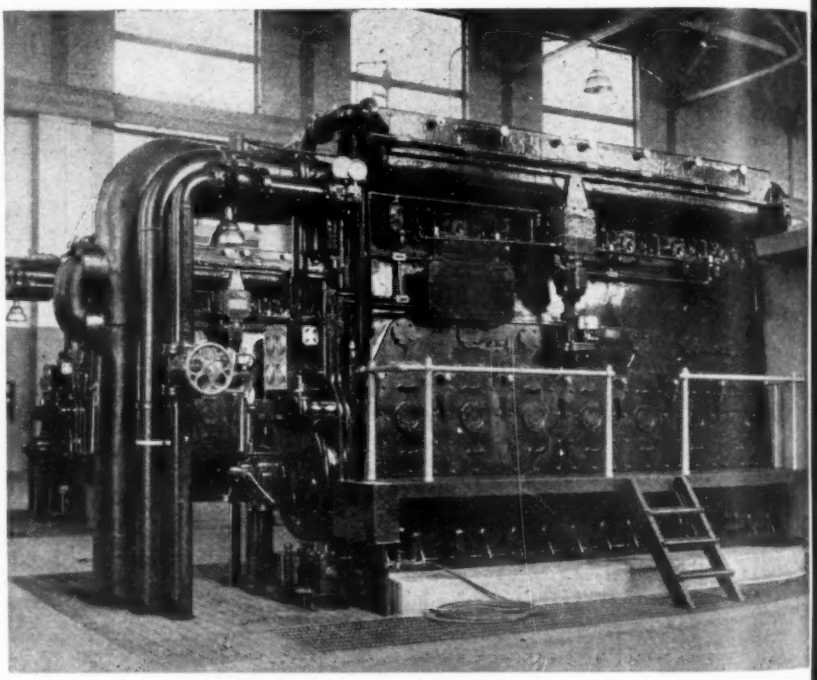


Fig. 1—Two 800-hp 7-cylinder 300-rpm sludge-gas engines connect directly to 560-kw 208-v 60-cycle ac generators that supply power to compressor and pump motors

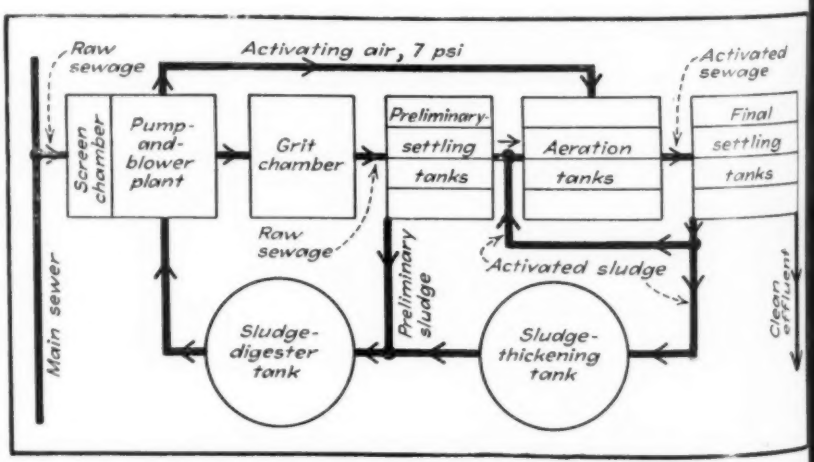


Fig. 2—Simplified diagram of raw-sewage flow through the treatment works and the recovery of sludge gas for power generating and for plant-and-process heating

New York City's sludge-treatment works are among the largest in the world. Its new Bowery Bay plant has an extensive arrangement of power and heating equipment, including operation of two 800-hp digester-gas engines connected to 560-kw ac generators

power generation and heating purposes.

Grease recovery, a recent development, provides another profitable by-product from sewage treatment. Scum from the sewage-settling tanks contains 75 to 80% fat on a dry basis. Prompted by a desire to make this fat available to the war effort, the city of New York began an investigation over 18 months ago to determine the possibilities of its recovery and utilization. As a result of these studies, approximately 1,500,000 lb of scum is now recovered and sold annually from Wards Island. Bowery Bay, Tallmans Island, Coney Island and Jamaica plants. Thus, a waste product has been turned into badly needed war material, in large amounts, and the city gets several thousand dollars annually without additional operating cost.

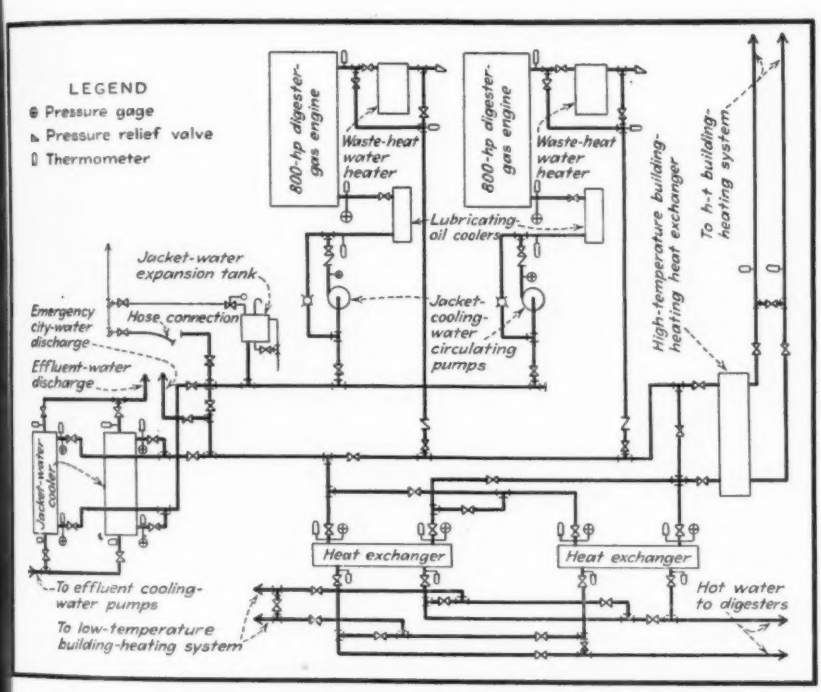


Fig. 3—Piping for heat recovery from lubricating oil, engine jackets and exhaust gas and heat disposal in sludge digesters, building heating and coolers

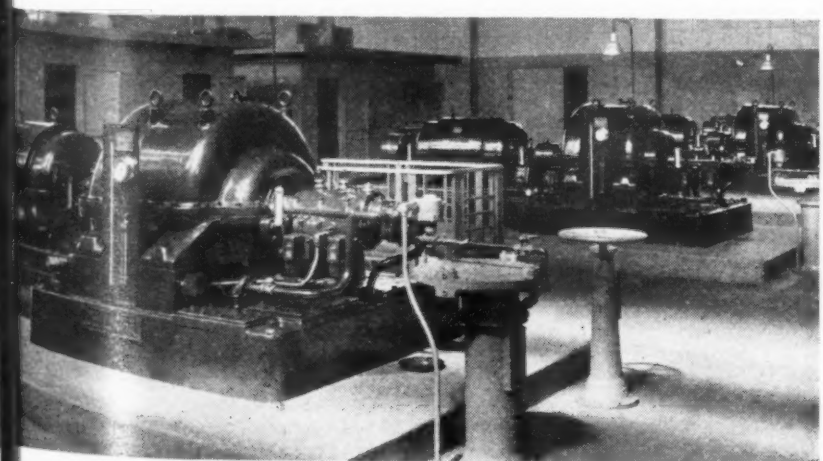


Fig. 4—Four 10,000-cfm 7-psi 2-stage blowers, driven by 500-hp 3600-rpm wound-rotor motors supplying air for activated-sludge sewage treatment tanks

New York City, a leader in sewage treatment and generating power from sewage-digester gas, now has 25,600 hp of digester-gas engines in service, or projected for installation as soon as conditions begin to return to normal (See table). On July 1, 1941, the country's sewage-treatment plants had only 22,000 hp in digester-gas engines, of which 8780 hp were in New York City. Since then, the Jamaica plant has placed in operation 4320 hp more of these engines.

Amount of digester gas available for power generation and heating depends on (1) type of plant, which governs the quantity of solids removed from the sewage, (2) adequate digester capacity and (3) proper operation of the digesters. On the other hand, treatment given the sewage determines the power required for plant operation. For example, Coney Island gives sewage preliminary treatment only, supplemented by chemical precipitation and chlorination in summer, consequently its chief power load is for pumping. In 1943 this plant, operating at 53-mgd capacity, produced 92,000,000 cu ft of digester gas, sufficient to supply all its power (4,100,000 kwhr) and heating.

Activated-Sludge Plant

Tallmans Island, an activated-sludge plant, has a much larger power load, per million gallons of sewage treated, than the Coney Island plant because of the large volume of low-pressure air required in the activated-sludge tanks. In the Tallmans Island plant gas engines drive the main sewage pumps and the blowers that supply the low-pressure air. Power is purchased for driving booster pumps, for all auxiliary drives, and for lighting. During 1943, this plant treated on an average 14 mgd of sewage from which 65,000,000 cu ft of gas was recovered. In addition, 620,000 kwhr of electric energy was purchased to supply auxiliary power and the lighting loads.

And now for a description of the Bowery Bay plant. One of the more recent to go into service, it gives a general picture of the power requirements and equipment in an electrically operated activated-sludge plant. Power for driving pumps and for supplying low-

pressure air comprises a large part of the plant load.

Raw sewage is pumped from the wet well by two 42-mgd and two 21-mgd bottom-suction vertical non-clogging centrifugal pumps into the treatment system, Fig. 5. These pumps, located in a dry pit, always operate with a static head on their suction. The large pumps, driven by 400-hp wound-rotor motors, and the small ones by 200-hp, Fig. 6, have 15-point speed regulators automatically actuated by a wet-well float to maintain the most efficient suction head, which is 4 to 5 ft. Speed of the pumps can be regulated to control their discharge over a range of 50 to 100% capacity. With this arrangement, pump discharge can be regulated from one half the capacity of one small pump (10.5 gpd) up to the full capacity of the pumps in service.

A hand-operated gate valve in the suction and a compressed-air operated cone valve in the discharge of each pump permits isolating it from the system. The air-actuated cone valve operates automatically as a check valve, opening when the pump starts and closing when it stops.

Centrifugal Blowers

Air for the activated sludge tanks is supplied at 7 psi by four 10,000-cfm 2-stage centrifugal blowers driven by 500-hp 3600-rpm wound-rotor motors. They are pushbutton started and operate at constant speed. A compressed-air-operated cone valve in the discharge of each compressor acts as a check valve, automatically opening when the compressor comes up to speed and closing when it stops. Air flow to the activated-sludge tanks is regulated manually when necessary by a butterfly valve in the intake of each blower. Air to these tanks passes through porous plates in their bottoms. Pores in the plates are so small that dirt in ordinary

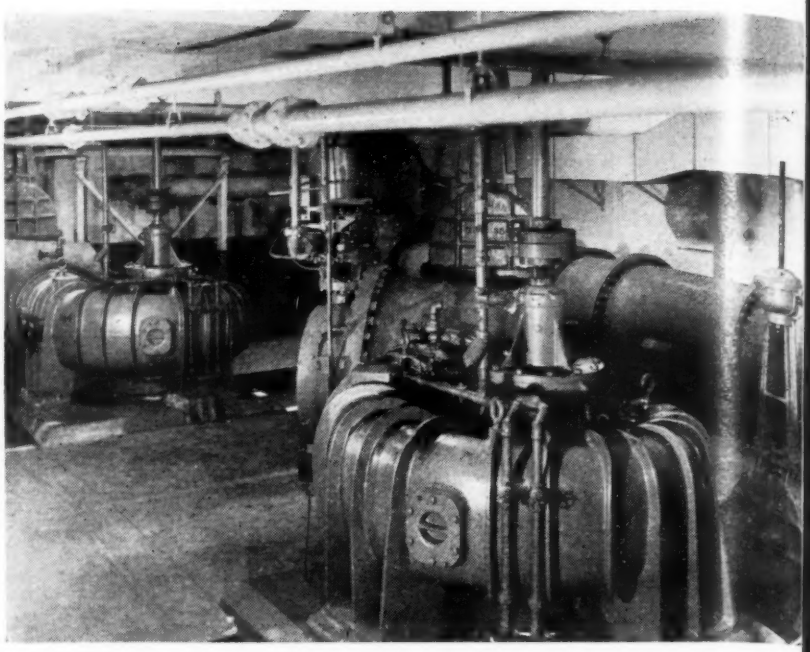


Fig. 5—Two 42-mgd and two 21-mgd bottom-suction centrifugal pumps in a dry pit take raw sewage from the wet well and discharge it to treatment processes

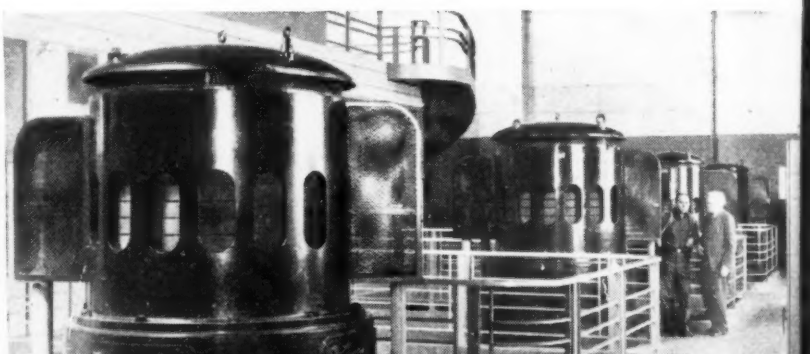


Fig. 6—These 400- and 200-hp wound-rotor motors drive the raw-sewage pumps at speeds that permit regulating their discharge from 50 to 100% rated capacity

Digester-Gas Engines Installed in or Projected for New York City's Sewage-Treatment Plants

	Engines							
Plant	*Year installed*	*No. of engines*	*Capacity each, hp*	*Total hp*	*Speed rpm*	*No. of cylinders*	*Kind of load*	*Load rating*
Coney Island	1936	3	300	900	400	5	Ac gen	200 kw
Coney Island Ext	1941	3	900	2700	327	8	Ac gen	600 kw
Tallmans Island	1939	2	800	1600	300	8	Blowers	20,000 cfm
Tallmans Island	1939	2	450	900	327	4	Blowers	10,000 cfm
Tallmans Island	1939	2	360	720	400	6	Cent Pump	35 mgd
Tallmans Island	1939	2	180	360	400	3	Cent Pump	15 mgd
Bowery Bay	1941	2	800	1600	300	7	ac gen	560 kw
Jamaica Bay	1943	3	1440	4320	257	8	Ac gen	1000 kw
26th Ward	Designed	3	1300	3900	257	8	Ac gen	900 kw
Hunts Point	Projected			3600				
Owls Head	Projected			5000				

atmospheric air would soon clog them. To eliminate this difficulty all air to the blowers passes through an electrostatic air cleaner that removes over 90% of all solids from it.

Compressed air, to operate the cone valves on the pumps and blowers, for the ejection of grit from the grit chamber to the storage hoppers, and for other purposes, is supplied by two 100-psi 150-cfm motor-driven compressors.

Two 800-hp 7-cylinder 300-rpm heavy-duty fully inclosed sludge-gas engines, Fig. 1, with removable cylinder liners, separate cylinder heads and oil-cooled pistons, connect directly to 700-kva 0.80-pf 208-v 3-phase 60-cycle generators. On test, they developed a brake-horsepower-hour on a gas consumption equivalent to 9584 Btu. Ultimate plans provide for a total of four 2000-hp engines within 25 years when the estimated normal sewage flow will amount to 120 mgd, three times the present rated capacity of 40 mgd. During 1943, operation averaged 36.5 mgd of sewage treated, from which 75,000,000 cu ft of sludge gas was recovered. Most of this gas was used in the two engines, which produce 2,900,000 kwhr. Heat recovered from engine jacket water and exhaust gas did practically all heating

(*Continued on page* 136)

PRINCIPAL POWER, PUMPING AND COMPRESSED-AIR EQUIPMENT

Bowery Bay Sewage Treatment Wor ks, City of New York, Astoria, N. Y.

GAS-ENGINE EQUIPMENT:

Gas engines.....Rathbun Jones Engrg Co
2, 800-hp, 7-cylinder, 15.5-in. pistons, 22-in. stroke, 1100-fpm piston speed, 300-rpm
Exhaust silencers, 2.....Maxim Silencer Co
Jacket-water circulating pumps, 2, 260 gpm, 110-ft head
Ingersoll-Rand Co
Jacket-water cooling-water pumps, 2, 300-gpm, 35-ft head
Ingersoll-Rand Co
Exhaust-gas water heaters.....Whitlock Mfg Co
2, each 260 gpm, temperature rise 10 F
Water-to-water heat exchangers.....Griscom-Russell Co
2, each 260-gpm jacket water, 150 to 115 F; 300-gpm digester water, 110 to 130 F
Jacket-water coolers.....Griscom-Russell Co
2, each 520 gpm, 140 to 115 F, cooling water, 1300 gpm, 70 to 80 F
Lubricating-oil transfer pumps, 2, 20-gpm, 50-psi....Goulds Pumps, Inc
Engine-starting and piston-cooling oil pumps.....Goulds Pumps, Inc
2, 20-gpm, 50-psi
Lubricating-oil clarifiers, 3, 100-gph.....Briggs Clarifier Co
Lubricating-oil centrifugal purifier, 100 gph.....Goulds Pumps, Inc
Gas-engine starting air compressors, 2, 40-cfm, 250-psi..Ingersoll-Rand Co
Pump and compressor motors.....U. S. Electrical Motors, Inc
Motor starters.....Westinghouse Elec & Mfg Co
Auxiliary starting air compressor.....Ingersoll-Rand Co
1, gas-engine-driven, 8-cfm, 250-psi
Starting air tanks, 4, 30 cu ft, 250-psi.....Scaife Co

ELECTRIC POWER SUPPLY EQUIPMENT:

Generators.....Electric Machinery Mfg Co
2, 560-kw, 80% pf, 208-v, 3-phase, 60-cycle
Exciter, direct-connected, 115-v.....Electric Machinery Mfg Co
Air-break circuit breakers.....I-T-E Circuit Breaker Co
Switchboard, meters and voltage regulators..Westinghouse Elec & Mfg Co
Crane, 5-ton, Shaw-Box.....Manning, Maxwell & Moore

SEWAGE PUMPS:

Main sewage pumps.....DeLaval Steam Turbine Co
2, 42 mgd, and 2, 21 mgd, 300-rpm vertical, bottom-suction, non-clogging centrifugal
Main sewage-pump motors.....Burke Electric Co
2, 400-hp, and 2, 200-hp, 300-rpm, 208-v, 3-phase, 60-cycle wound-rotor
Motor starters & 15-point speed controllers..Westinghouse Elec & Mfg Co
Pump-suction gate valves.....Chapman Valve Mfg Co
Pump-discharge air-operated cone valves.....Chapman Valve Mfg Co
Return sludge pumps, 3, centrifugal, 7000 gpm...Morris Machine Works
Sludge-pump motors, 30-hp.....Burke Electric Co
Starters.....Westinghouse Elec & Mfg Co
Excess-sludge pumps, 2, centrifugal, 1500-gpm....Morris Machine Works
Excess-sludge-pump motors, 20-hp.....Burke Electric Co
Sludge pump, triplex plunger.....Marlow Pumps
Sludge-pump motor, 7.5- to 15-hp.....U. S. Electrical Motors, Inc
Reduction gears.....Philadelphia Gear Works
Sludge pump.....Guild & Garrison, Inc
Sludge-pump motor.....U. S. Electrical Motors, Inc

BLOWERS AND COMPRESSORS:

Blowers.....DeLaval Steam Turbine Co
2-stage centrifugal, 10,000-cfm, 7-psi, 3600-rpm
Blower motors.....Elliott Co
500-hp, 3600-rpm, 208-v, 60-cycle, 3-phase wound rotor
Blower-motor starters, pushbutton.....Westinghouse Elec & Mfg Co
Electrostatic air filters on blower suctions.....American Air Filter Co
Blower-discharge air-operated cone valves....Chapman Valve Mfg Co
Blower, butterfly valves, manually operated.....Chapman Valve Mfg Co
Oil-temperature and pressure relays.....General Electric Co
Service air compressors, 2, 100-cfm each, 100-psi.....Ingersoll-Rand Co
Air-compressor motors.....U. S. Electrical Motors, Inc
25-hp, squirrel-cage, 1800-rpm
Air-compressor motor starters.....Westinghouse Elec & Mfg Co

HEATING-SYSTEM EQUIPMENT:

Boilers, 2, firetube, 15-psi.....National Radiator Co
Oil burners, 1 per boiler.....Simplex Oil Heating Corp
Gas burners, 1 per boiler.....Simplex Oil Heating Corp
Boiler automatic control.....Minneapolis-Honeywell Regulator Co
Fuel-oil heaters, steam, 4.....Davis Engineering Corp
Fuel-oil heater, electric.....Westinghouse Elec & Mfg Co
Fuel-oil pumps, 2.....Simplex Oil Heating Corp
H-t heating system, water-to-water heat exchanger....Griscom-Russell Co
H-t heating-system, steam-to-water heat exchanger...Griscom-Russell Co
H-t heating-system circulating pumps, 2
Worthington Pump & Mach Corp
L-t heating-system circulating pumps, 2
Worthington Pump & Mach Corp
Condensate-return and boiler-feed pumps, 2.....Economy Pumps, Inc
Pump motors.....Howell Electric Motors Co
Motor starters.....Westinghouse Elec & Mfg Co
Digester heating-water pump, 1, reciprocating....Union Steam Pump Co
Digester-pump reduction gears.....Philadelphia Gear Works
Digester heating-water pumps, 2, centrifugal.....Ingersoll-Rand Co
Digester pump motors, 3, 10-hp.....U. S. Electrical Motors, Inc

VALVES, TRAPS AND STRAINERS:

Gate valves.....Crane Co; Chapman Valve Mfg Co; Jenkins Bros
Globe Valves.....Crane Co; Chapman Valve Mfg Co; Jenkins Bros
Check valves.....Kennedy Valve Mfg Co
Solenoid-operated valves.....Automatic Switch Co
Motor-operated valves.....Chapman Valve Mfg Co
Pressure-regulating valves.....J E Lonergan Co
Relief valves.....Manning, Maxwell & Moore
Thermostatically operated valves
Automatic Temperature Control Co, Inc
Traps.....Sarco Co
Strainers.....Kraissl Co, Inc

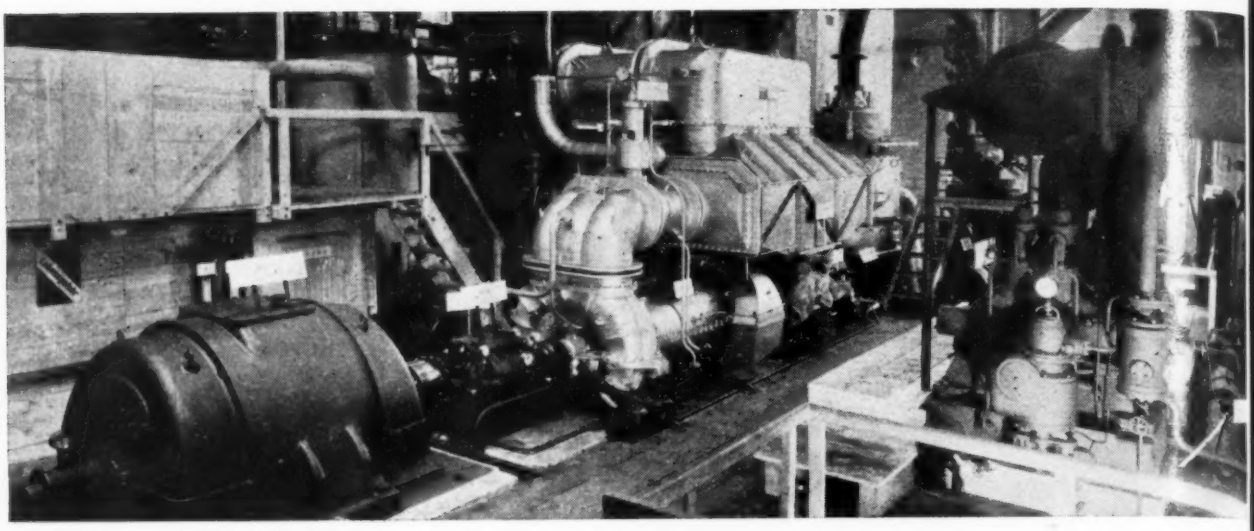
METERS:

Flowmeters, steam.....Cochrane Corp
Flowmeters, water.....Bailey Meter Co
Flowmeters, air.....Simplex Valve & Meter Co
Flowmeters, gas.....Roots-Connersville Blower Corp; Builders-Providence, Inc
Flowmeters, fuel oil.....Ralph N Brodie Co
Condensate meters.....American District Steam Co
Fuel-oil level gages.....Uehling Instrument Co
Pressure gages, indicating.....Manning, Maxwell & Moore
Pyrometers on engines.....Weston Electrical Instrument Co
Thermometers, mercury.....Philadelphia Thermometer Co
Thermometers, recording.....C J Tagliabue Mfg Co
Temperature recorders.....Brown Instrument Co

SEWAGE-TREATMENT EQUIPMENT:

Traveling screens.....Link-Belt Co
Screening grinders; grit washers; elevators and collectors; sludge collectors.....Jeffrey Mfg Co
Screening grinder motors, 3-hp.....General Electric Co
Grease skimmers.....American Well Works
Grit air ejectors.....Krajewski-Pesant Mfg Corp
Sewage samplers.....Chicago Pump Co
Chlorinators.....Wallace & Tiernan Products, Inc
Sewage strainers.....Krajewski-Pesant Mfg Corp
Thickener tanks.....The Don Co

Prospects for Gas-Turbine Power



Built for inlet temperatures around 1200 F and 120-psi gage, combustion gas turbines require 5 to 6 cubic feet per kw and cost about $50 per kw installed with auxiliaries and generator switchboard. Special uses will provide experience

By PAUL R SIDLER,
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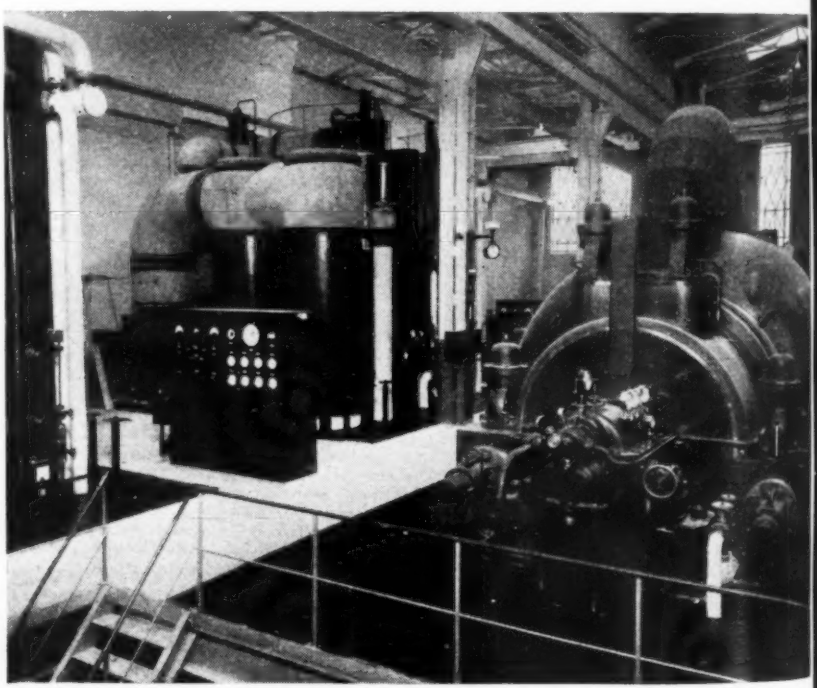
Fig. 2—Two 176,000-lb-per-hr Velox steam generators supply a 31,500-kw turbine with 400-psi 800-F steam at Oslo, Norway. Note boiler is near turbine



▶ BASING THEIR OPINION on 40 years of accumulated experience in development of gas turbines, Brown Boveri engineers feel certain that continuous combustion units will find practical application as soon as materials are available. Designers will neither have to go to extremes in temperature or pressure nor sacrifice low cost, small space and simple layout achieved in the several units already in service. Some 35 turbine-compressor units built by two manufacturers are now in regular operation in the United States, while more than 75 others are employed with Velox boilers in stationary plants throughout the world.

Although the primary purpose of these machines is the supply of air under conditions dictated by aviation gasoline refining or by desired furnace supercharging in the Velox, nearly all make a byproduct electric-power surplus ranging from a few kw to some 1200 kw. They are, therefore, power units in the true sense of the word.

While the refinery units normally operate at temperatures below 1000 F, the original Brown Boveri designs are based on 1112 F (600 C). The relatively conservative step upward to 1200 F can be immediately expected with present known materials.

A single-shaft gas-turbine power plant can be constructed, when war conditions permit, for 1200 F and 60 psi-gage pressure in 4000- to 8000-kw size range, delivered and installed in the United States for about $50 per kw. Such a unit would include, perhaps, 2½ sq ft per kw of heat exchanger, auxiliaries and generator switchboard. A heat rate better than 14,000 Btu per kwhr net sendout could be expected.

Such a power unit would require a minimum space of about 6 cu ft per kw. It would be limited, as far as present information is available, to liquid or gas fuel. No cooling water is needed. Maintenance, based on experience with ex-

Fig. 1—Experimental 1500-kw pulverized-fuel-fired combustion gas turbine with heat exchanger on test floor at Baden, Switzerland. No results yet available

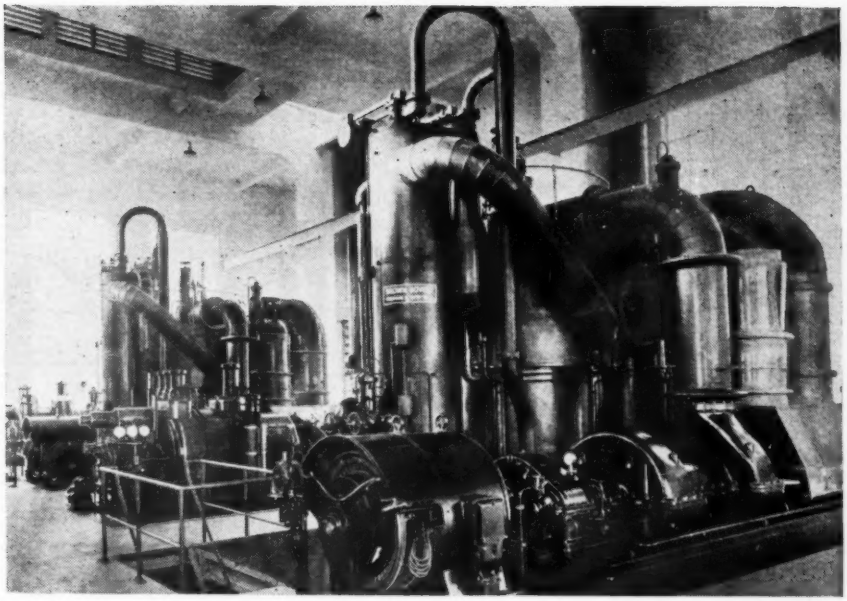
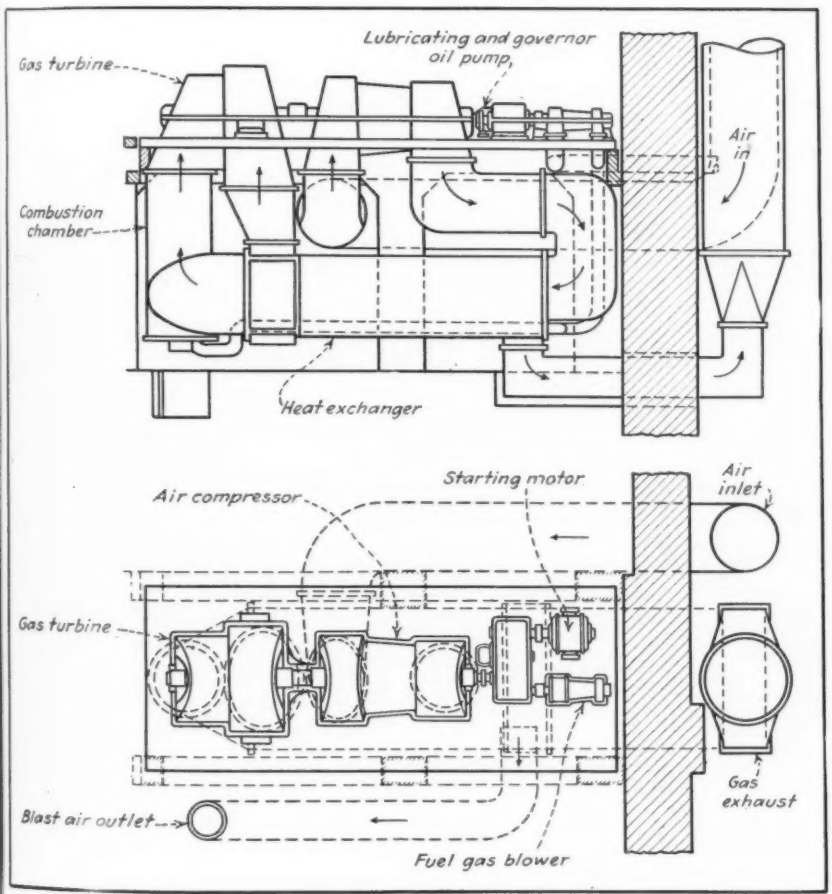


Fig. 3—Two Velox units, gas-turbine auxiliary of one in foreground, develop 2100 kw each from half their steam output for Argentine oil refinery

Fig. 4—Gas-turbine-driven blower unit rated at 100,000 cfm supplies 35,000 cfm of blast air to steel mill at 17-psi gage pressure, plus compressed gas fuel



isting machines, would be comparable to that of a steam turbine.

Improvements in efficiency of the cycle can be obtained without increasing initial temperature conditions if added plant complication and some extra cost are justified. Methods and equipment parallel those employed in steam-turbine practice: (1) reheating between turbine stages (2) intercooling between compressor stages (3) heat recovery from exhaust gas and (4) increasing initial pressure.

For a relatively small unit around 4000 kw intended for power generation at varying load, there would be two gas turbines supplied by a single combustion chamber, one driving the compressor at variable speed to suit load conditions and another driving the generator at constant speed. For 8000 kw or larger, it would probably be desirable to go to two pressure stages (120-psi gage) and add a reheater combustion chamber between turbines as well as one stage of intercooling. For 1200-F inlet temperature to the gas turbines, a heat rate close to 12,000 Btu per kwhr net sendout would be possible.

Varied Applications

With efficiencies of this sort, it would seem entirely practical to find application for gas-turbine units without awaiting development of materials that would permit, as some have suggested, gas temperatures as high as 1500 F. Nor does the present limitation to liquid or gas fuel present too great an obstacle where such fuels are now commonly accepted as, for example, in locomotive and ship drives or steel-mill blowers.

Experiments with burning pulverized fuel were undertaken some time ago on a 1500-kw unit, Fig. 1, but no information on results is available in the U. S. Considerable time, it is expected, must elapse before satisfactory performance of solid fuels can be surely predicted.

As has been pointed out from time to time, the present form of combustion gas turbine was originally developed as an auxiliary to the Velox boiler, which depends for its compactness (about one tenth that of watertube boilers of conventional construction) on supercharging the combustion space to 20–35 psi. In a sense the Velox unit represents a

gas-turbine application where it is desired to take the entire output of the fuel as high-pressure steam, and such small amounts of power as may be incidental to the gas-turbine auxiliary set are purely a welcome byproduct.

An example of such installations is afforded by the initial plant at Oslo, Norway, Fig. 2, first operated in 1936. Two Velox steam generators with their auxiliary gas-turbine axial-compressor sets are located in the same room and almost alongside the 31,500-kw steam-turbine generator.

A novel arrangement of alternate steam and gas turbines is found in the power plant of an Argentine oil refinery. About half the 60,000-lb-per-hr steam output of the Velox steam generators shown in Fig. 3 goes to process, the other half being used for power generation. The gas-turbine sets, of course, handle the total volume of combustion air and flue gas, but produce a negligible amount of electric power.

In the future it will be entirely practicable to utilize only a small amount of steam-generating surface around the combustion chamber to supply a specified quantity of process steam. Additional electric power can then be taken from the gas-turbine set, thus eliminating the need for the steam-turbine unit.

Another application, already translated into practice in two instances, is found in blast-furnace plants. With blast-furnace gas as fuel, the gas-turbine net output can be taken from the compressor as blast air under any desired pressure. The gas-turbine arrangement, Fig. 4, for this use would also include a small geared blower for compressing the gas fuel, as well as a starting motor.

The unit of Fig. 4 is designed for an air flow of 100,000 cfm, of which 35,000 cfm is extracted as blast air at 17-psi gage. It will be practicable to arrange for 25-psi blast air, as is customary in this country, or for any other desired pressure up to, say, 120-psi gage.

Space Saving

The efficiency of such arrangement is substantially higher than that of a boiler and steam turbine driving a centrifugal blower, as is now accepted practice. In addition, as in Fig. 4, the scheme lends itself well to the addition of a relatively large heat exchanger to obtain high blast temperature. The entire blast unit shown can be installed in a space 32 ft long by 13 ft wide, a considerable space saving over that required by present installed equipment.

The gas turbine for blast-furnace charging also suggests the thought of supercharging the blast heater and using the gas-turbine combustion chamber for blast heating. In this manner, dimensions of the heating plant can be reduced to a small fraction of their present size with Cowper stoves.

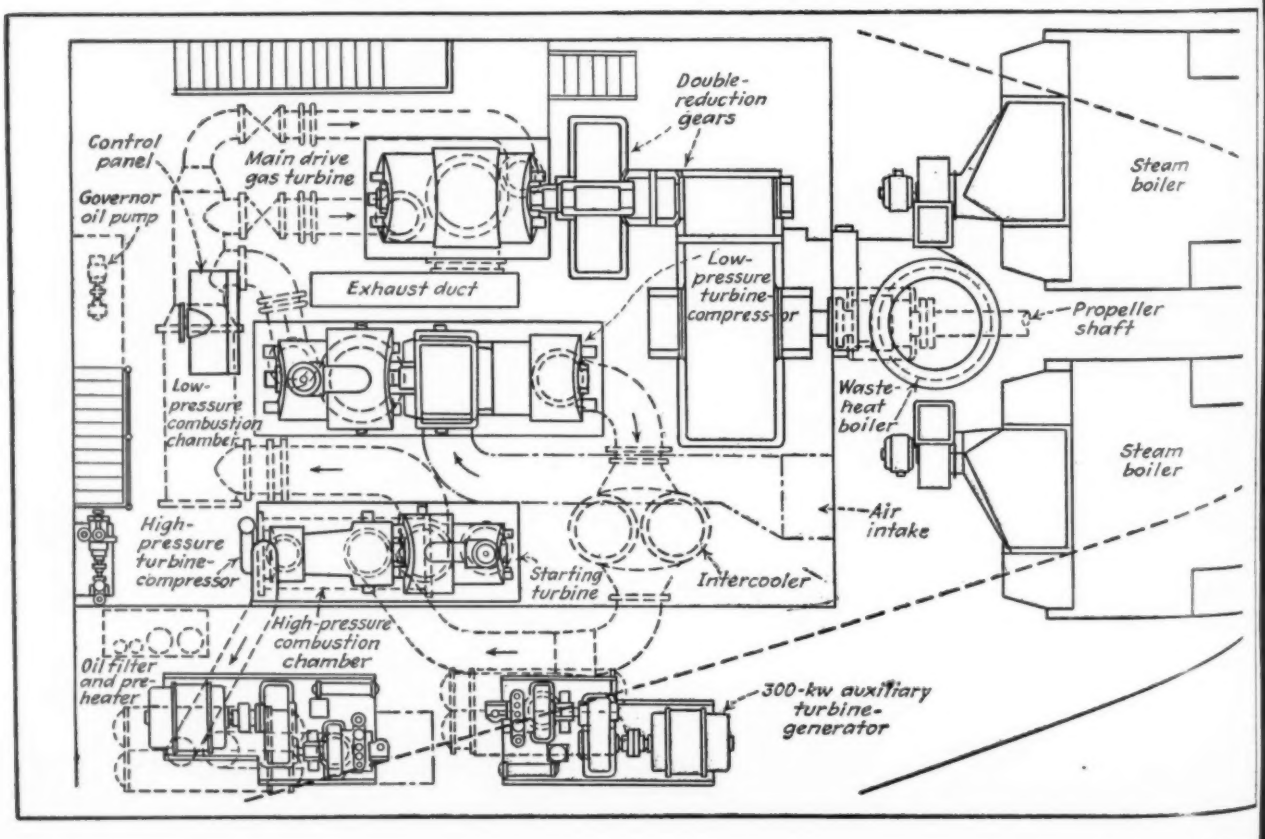
Gas-turbine drive for ships looks most promising. By using one separate gas turbine for the net useful power and another to drive the compressor unit, it is readily possible to obtain the advantages of gear drive.

Fig. 5 shows a definite project for a commercial tanker which was worked out and accepted just before the war. Two-stage compression with intercooling reaches a final pressure of 132-psi gage. A separate 4000-hp power turbine drives the propeller through double reduction gearing 6500:75 rpm. The 2800-hp astern turbine is on the same shaft with the propeller turbine.

Over-all thermal efficiency for this ship drive, which includes no heat exchanger, is about 21%, corresponding to a fuel consumption of 0.68 lb of bunker oil per shaft horsepower comparable to that of steam-turbine drives.

Since the gas-turbine unit offers advantages for propulsion machinery, blast-air supply and certain stationary power applications without exceeding temperature limits for known materials, it is not too difficult to predict that early postwar years will see development in these fields.

Fig. 5—Gas-turbine layout for 4000-hp ship drive employs two pressure stages, intercooling and double-reduction gear



Pivoted Motor Bases Keep Correct Tension in Flat-Belt Drives

Two types of pivoted motor bases, gravity and reaction torque, maintain correct belt tension. Success depends on observing seven important requirements here outlined*

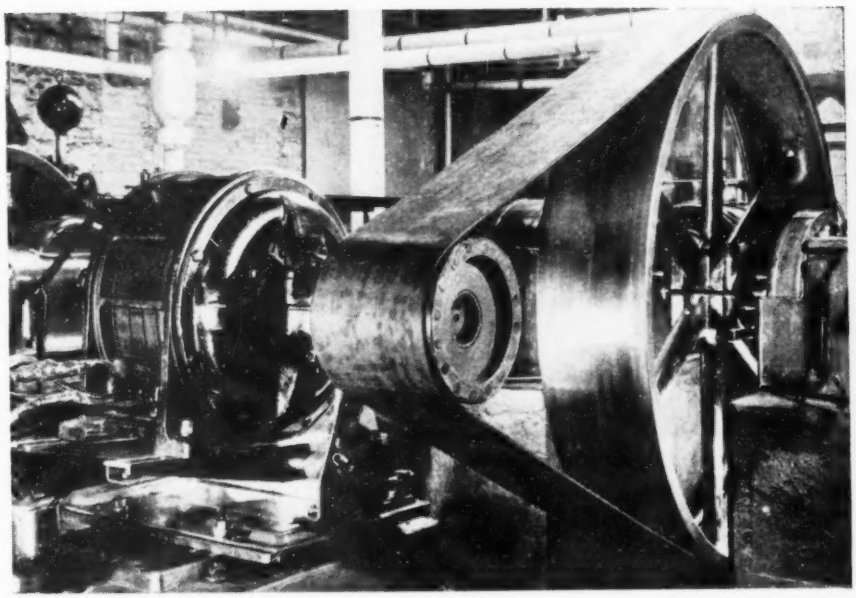


Fig. 1—Tension-control motor base adjusts tension in 15-in. belt running on 16.5- and 84-in. pulleys and connects a 100-hp 865-rpm motor to an air compressor

▶ ON LONG-CENTER FLAT-BELT DRIVES, sag of the slack strand, belt elasticity and other factors contribute to frictional grip between belt and pulley with normal belt tension. On short-center drives, however, these factors are so reduced that unless external means are provided to maintain correct tension in a belt automatically, it must operate with abnormal tension. Tight belts have short life and cause excessive wear of the bearing next the pulley and require frequent adjustment.

To overcome these difficulties, automatic belt-tension devices were developed, such as pivoted-motor bases. They are available in two designs—*gravity* and *reaction torque*. Although the mechanical details of the two designs are different, they both automatically maintain belt tension and accommodate themselves to belt stretch.

Gravity pivoted-motor bases, Fig. 3 to 6, use part of the motor weight to maintain belt tension automatically under different loads. In the gravity base, Fig. 3, the pivot about which the motor moves is located below its feet.

Reaction-torque pivoted-motor bases, Fig. 7 to 10, utilize reaction between motor stator and rotor to change belt tension automatically according to load. In the reaction-torque base, Fig. 7, the pivot is placed above the motor feet and near its shaft.

Here's how the two types of bases operate:

Gravity pivoted-motor base consists of a cast-iron or welded-steel base, *B*, a pivot shaft, *S*, and two cast-iron or steel motor-supporting arms, *A*, Fig. 3. Sleeves on the pivot shaft permit moving the arms to accommodate motors of different widths. Longitudinal slots in the motor arms take care of variations in motor lengths. The motor, without slide rails, bolts to the pivoted arms, supported at one end by adjustable bronze-bushed bearings on the pivot shaft in the base, which in turn is secured to the structure that supports the motor. An adjustment permits moving the motor either toward or away from the pivot to obtain correct belt tension. Once made, this adjustment for a given load need never be changed, and belt tension will be constant at all times.

There are three general types of gravity pivoted-motor bases: (A) floor or standard, (B) ceiling and (C) vertical.

(*A*) *Floor or standard base*, Fig. 3, is suitable for mounting on the floor, or when turned 90 deg on the wall, Fig. 4. On horizontal drives with driven pulley above the driver, motor tilts on the pivot shaft and automatically maintains belt tension. The pivoted motor's weight cradled through its pulley in the belt maintains tension as the belt elongates through either stretch or centrifugal force. Do not let motors equipped with ring-oiled bearings tilt more than 8 to 10 deg above or below horizontal. Set the oil cups on the oil-reservoir side toward the pivot shaft so that, in case of excessive tilt, oil spillage is a minimum. Anti-friction bearing motors can be tilted through any angle, as long as the motor arms do not rest on the base.

Since a motor mounted on a pivoted base is free to move, variations in belt thickness and pulley eccentricities may cause slight movement, but unless these variations are extreme there is little cause for trouble. The motor base might be considered as a buffer, absorbing irregularities that would otherwise produce shock in the driven machine. The motor cannot be turned over by the belt. As soon as the motor starts to lift, belt tension is relieved and it drops back until held by the pulley cradled in the belt. If the belt breaks or flies off, the motor drops down until the arms rest on the base, and do no damage.

The seven important factors in the operation of pivoted-motor bases are: (1) horizontal distance from pivot-shaft center to motor center, (2) location of tight strand of belt or direction of belt pull, (3) ratio between driving and driven pulleys, (4) slope of drive, (5) peak load to be transmitted, (6) weight of motor, (7) operating conditions.

Horizontal distance, overhang, from pivot-shaft center to motor-shaft center,

* Material in this article made available by the Power Transmission Council, New York, N. Y.

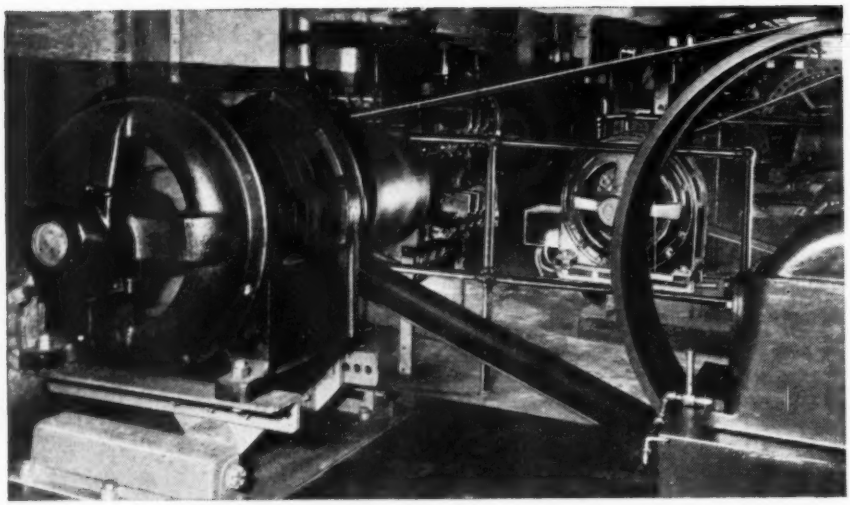


Fig. 2—A 125-hp 900-rpm squirrel-cage motor and a 75-hp 900-rpm one, mounted on pivoted bases, maintain tension in flat belts driving air compressors

Fig. 3, is the most important factor in the operation of a gravity-motor base, because this distance more than any other factor determines the belt tension. With a pivoted-motor base mounted on the floor, tight strand of belt should be nearest the pivot. Under these conditions when load increases and belt stretches, motor weight causes it to tilt, thereby tightening the belt and maintaining tension. If the belt tight strand is farthest from the pivot, operating conditions are not as favorable as in Fig. 3 and considerable overload capacity is lost.

For best practical results, ratio of drive- and driven-pulley diameters should not exceed 1:7. When possible, locate drive-pulley center lower than that of the driven pulley, and select distance between centers from one to two times the larger-pulley diameter.

Correct belt tension in any drive is the least required to transmit peak load without excessive slippage. To obtain this value, with the gravity pivoted-motor base there is a correct setting. Determine this either graphically or mathematically, or by trial and error. Irrespective of how determined, when the drive has been installed check this setting at peak loads. Since a motor usually develops its maximum torque at about 75% normal speed, also check belt slip during starting. If there is no apparent slip at peak loads or during starting, the belt has sufficient tension.

A slow-speed motor of given horsepower is heavier than a high-speed one. Likewise, a totally inclosed motor or one of older design has greater weight than a NEMA standard of the same horsepower and speed. For these heavier motors, less overhang is required for correct belt tension than for a high-speed motor, and they should be set closer to the pivot.

If the application requires greater torques or belt tensions than normal, move the motor farther out on the arms away from the pivot shaft. Such applications include across-the-line-start motors, frequent starting, operation in dirty or oily atmosphere, and high fluctuating or jerky loads.

(*B*) *Ceiling base.* Motors suspended from the ceiling and driving-line shafts horizontally on short centers generally cause trouble for maintenance men. Belts stretch and lose their tension and, because of their inaccessibility, are usually neglected. Overcome these difficulties by mounting the motors on regular pivoted bases or on special ceiling designs.

In the special ceiling base, Fig. 5, extra hinge arms support the motor arms. An auxiliary pair of adjusting screws permit moving the motor relative to the pivot shaft, without supporting its weight by external blocking while changing its position. This is a convenience when working overhead from ladders or temporary staging. With the special design of mounting as with the regular, a portion of the motor weight is cradled through the pulley in the belt and a suitable belt tension automatically maintained.

(*C*) *All conventional vertical belt drives* are usually troublesome because belt weight is carried by the top pulley. Any increase in belt length decreases its tension, causing a corresponding in-

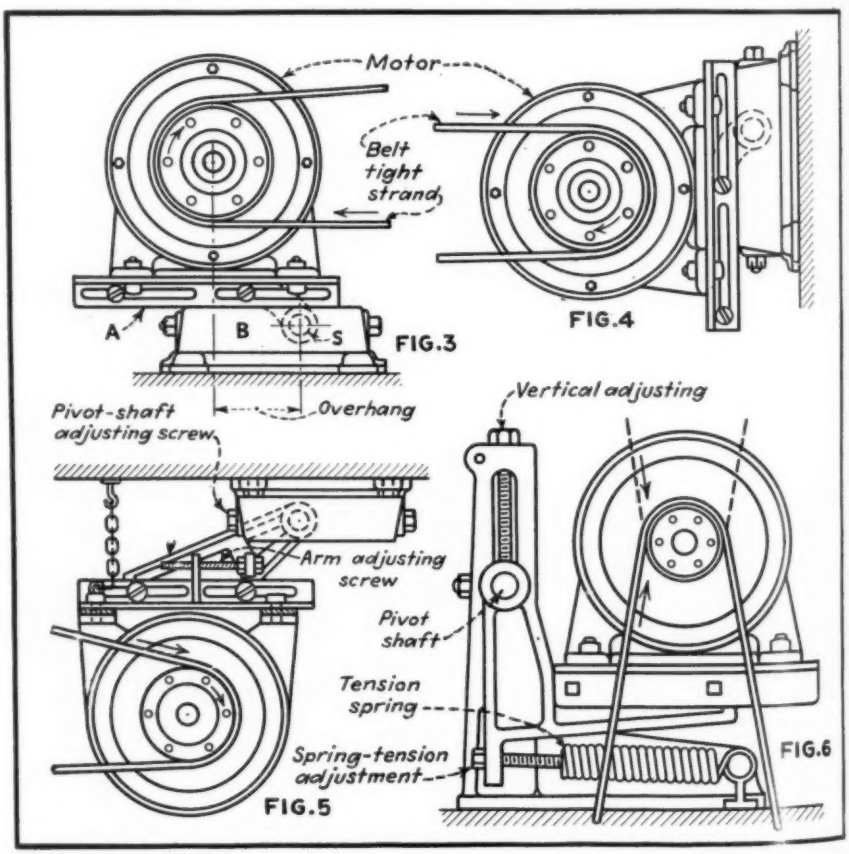


Fig. 3—Floor-mounted pivoted motor base. Fig. 4—Pivoted base supports motor on wall. Fig. 5—Pivoted-motor ceiling-drive base. Fig. 6—Pivoted-motor vertical-drive base. Note that the tight strand of the belt is next the pivot

creas in slip and a decrease in speed and power transmitted. A special pivoted-motor base, designed to overcome this condition, differs from a standard base in that tension in the belt is maintained by spring rather than by motor weight.

In the vertical-drive base, Fig. 6, the motor carried on a pair of arms, extending from the pivot shaft in the usual manner, has its weight counterbalanced by heavy spiral springs connected to the arm ends. With the motor above the driven pulley, springs are adjusted to support the entire motor weight, plus desired belt tension. With motor below the driven pulley, springs are adjusted to carry only that portion of motor weight not needed for belt tension. Load requirements determine spring tension which can be adjusted at any time. In this drive design, it is necessary to run belt with its tight side next to pivot shaft.

Reaction-torque pivoted-motor base depends for its performance upon one of the fundamental laws of physics: When current flows in an electric motor, torque develops which is harnessed through its rotor to drive an external load. When the rotor transmits useful torque to its load it also reacts magnetically on the motor stator with a force equal and opposite to that applied to the load. This action is similar to that of the body of an electric drill, which tends to turn opposite to its chuck. It is this opposing or reaction torque that is utilized in a reaction-torque pivoted-motor base to maintain belt tension proportional to load.

Standard reaction-torque pivoted-motor base, Fig. 7, consists of a steel baseplate with upright crank-bearing standards on either side that support steel cradle cranks. These cranks fasten on steel crossbars which carry pressed-steel motor-base arms. The cradle pivoted in self-aligning bronze bearings reduces possibility of binding to a minimum. The motor mounted on the arms is free to turn through a limited arc about the pivot axis.

Reaction-torque bases have three adjustments. Two screws in the baseplate adjust crank-bearing standards for pulley alignment and belt take-up. These adjustments can, if necessary, be made with the motor running. Motor arms have longitudinal slots that permit positioning the motor relative to the pivots. These arms can be moved along the cross rods to accommodate motors of different dimensions.

This type of base depending more on reaction torque than on gravity to maintain belt tension, can, in its standard form, be mounted on floor, Fig. 8, wall or ceiling, Fig. 9 and 10, without affecting its operation. The standard base is designed for and functions satisfactorily only on drives that have the belt tight side next to the pivot axis of the base, Fig. 8. Special bases can be had that give equal performance on reverse-direction drives.

When the base is properly selected and installed, the motor stator tends to turn about the pivot axis in a direction opposite to belt pull, and increases belt tension as load increases. The cradle pivot axis is placed close to the motor axis to obtain sufficient reaction effect as the load increases, thus swinging the motor slightly about the pivot axis, and increasing pulley-center distance and belt tension. Since reaction torque varies directly as load, motor position also changes with it and belt tension automatically adjusts to suit each load.

Vertical Drives

Vertical drives with the motor mounted above the driven pulley, have a special base, sometimes designated as a down drive, the motor weight being balanced by a counterweight placed on extended ends of the motor arms. With this exception, the drive is similar to a standard one. Depending on conditions, for vertical upward drives, use either a standard base or down drive.

Mathematical and graphical solutions have been developed for determining correct location of the motor for both types of pivoted bases. While their application is comparatively simple, the average operator has little need of them. Pivoted-base manufacturers furnish charts and installation data that, if carefully followed, provide a simple method of determining proper motor position.

Pivoted-motor base provides means for satisfactorily using flat belts on short-center drives. They are applicable to motors of all types and speeds, and provide an efficient drive for modern power applications. While the two general types of bases are simple in construction and operating principles, they cannot be selected and installed promiscuously. All factors that influence their performance must be considered and applications made according to manufacturers' recommendations. If this procedure is followed, the belt drive will be automatically regulated, long-lived and highly satisfactory.

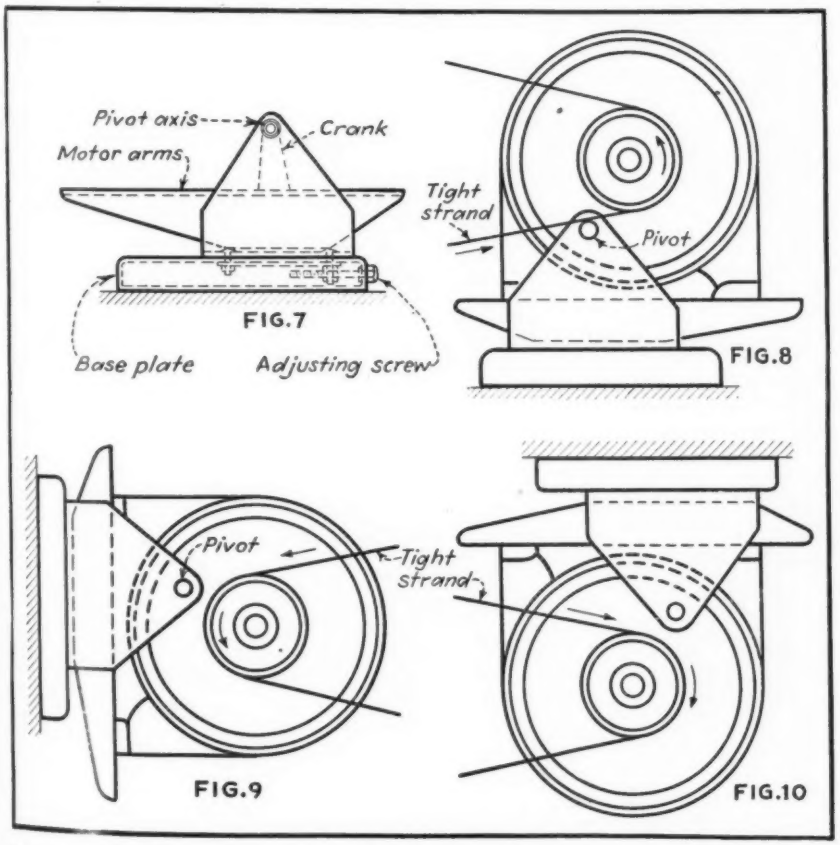


Fig. 7—Belt-tension-control motor bases use reactive motor torque to adjust belt tension. Fig. 8—Floor-mounted tension-control base. Fig. 9—Tension-control base on wall. Fig. 10—Tension-control base supported from ceiling

Critical Pressure Limits Isothermal Gas Flow in Pipes

Flow of air or gas under high pressure drop reaches a limiting condition at sound velocity. What the limit is and how to calculate the corresponding pressure loss is developed here by Professor R C Binder, Purdue University

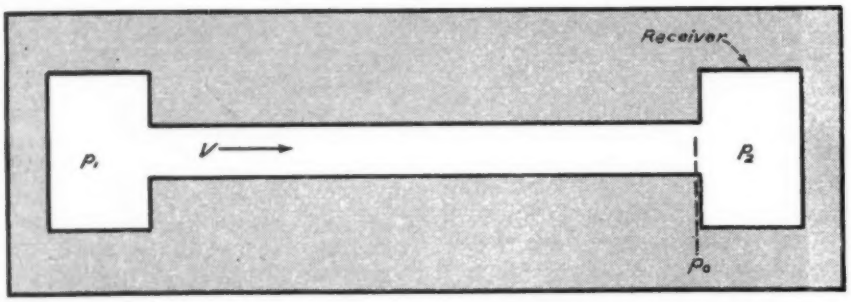


Fig. 1—Schematic conception of a piping system connecting a high-pressure supply with a receiver at lower pressure by a pipe of uniform cross-section

▶ ALTHOUGH MUCH ATTENTION has been devoted to the important, practical problem of fluid flow in pipes, some aspects have not been generally recognized or established. Much information on the simple relations for flow of incompressible fluids is readily available, but these well-known formulas should be applied with caution when dealing with flow of compressible fluids, such as air or gas at high velocities, or large pressure differences.

For example, a detailed study of gas flow shows that there is a limiting or *critical* pressure for expanding flow; the pressure in a constant-diameter pipe cannot fall below this critical pressure. An understanding of this phenomenon can be obtained from examining what happens in a pipe, assuming the flow of gas occurs at constant temperature.

Sound Velocity

A pressure impulse, a pressure disturbance or a pressure wave travels through a body of fluid at a velocity variously called "velocity of pressure propagation," "velocity of sound," or simply "acoustic velocity." This pressure wave is transmitted from one layer to an adjacent layer by alternate compressions and expansions and so on through the fluid. The wave travels with acoustic velocity whether the fluid is stationary or in motion.

Steady flow of gas through a constant-diameter pipe is illustrated in Fig. 1. Pressure decreases progressively along the pipe from inlet pressure p_1 because of frictional resistance. Specific volume of the gas increases because of the lowered pressure. Then, since the weight rate of flow is constant. the linear velocity, V, increases along the pipe.

If the pipe is the proper length, the pressure at the outlet end decreases to the critical pressure, p_o, at which the fluid is moving at the acoustic velocity. Fluid velocity in the pipe cannot exceed the acoustic velocity. If the pressure in the receiver, p_2, is lower than the critical pressure, this fact cannot be telegraphed back into the pipe since the speed of communication is limited to acoustic velocity and the fluid itself is moving at acoustic velocity.

Acoustic velocity of a gas, for example, for a constant-temperature process can be set down as:

$$c = \sqrt{gRT} = \sqrt{gpv} \qquad (1)$$

where

c is acoustic velocity, ft per sec

g is gravitational acceleration, (32.2) ft per sec per sec

R is gas constant, for air = 53.3

T is absolute temperature, F

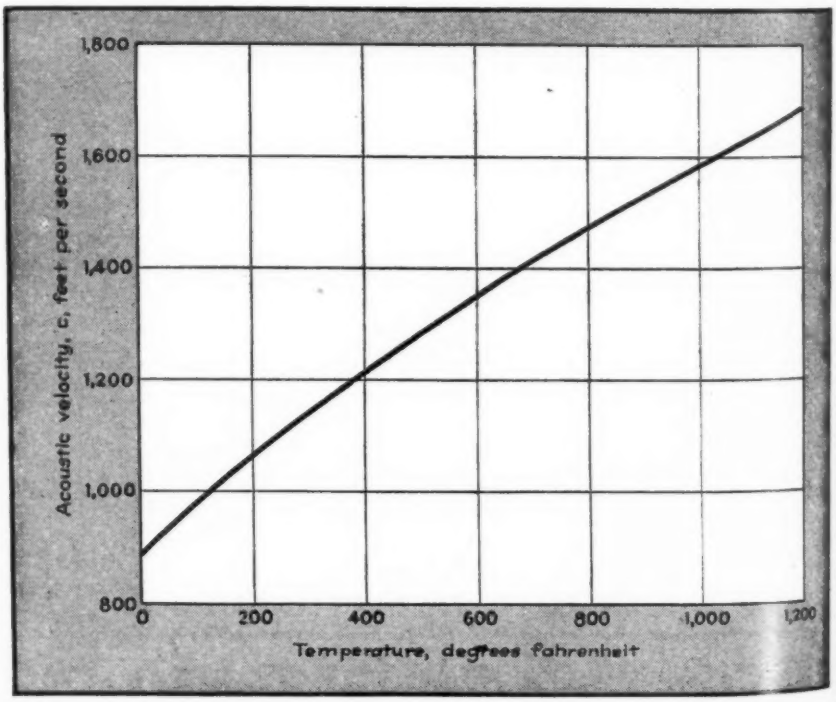


Fig. 2—Acoustic velocity increases materially with increase of temperature

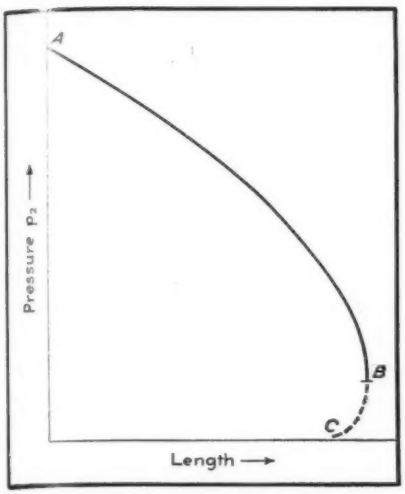


Fig. 3.—**Plot of pressure against length for flow through pipe at constant temperature. Point *B* locates the condition of critical pressure and acoustic velocity**

p is absolute pressure in lb per sq ft
v is specific volume in cu ft per lb.
From the equation it will be seen that the acoustic velocity varies directly as the square root of absolute temperature.

Fig. 2 shows a plot of acoustic velocity against temperature for air. For constant-temperature flow, the velocity of sound is constant along the pipe, and can be determined from the inlet conditions. For a constant diameter pipe:

$$\frac{V_1}{v_1} = \frac{V_*}{v_*} \text{ or } \frac{v_1}{v_*} = \frac{V_1}{V_*} \qquad (2)$$

where
V_1 is inlet velocity, ft per sec
v_1 is inlet specific volume, cu ft per lb
V_*, v_* are corresponding limiting or critical values at end of pipe.

Since the equation of state for constant-temperature flow is:

$$p_1 v_1 = p_0 v_0 \qquad (3)$$

combining equations (2) and (3) gives the relation:

$$\frac{p_0}{p_1} = \frac{v_1}{v_0} = \frac{V_1}{V_0} \qquad (4)$$

and since V_* equals the acoustic velocity, the pressure ratio becomes:

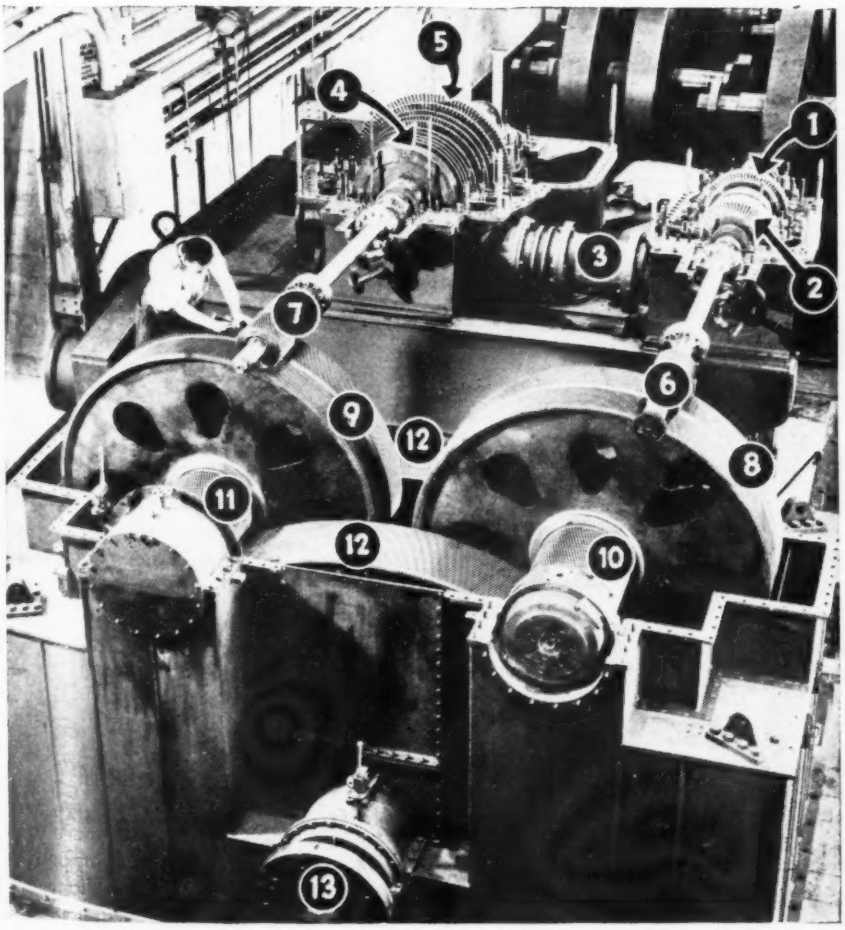
$$\frac{p_0}{p_1} = \frac{V_1}{V_0} = \frac{V_1}{\sqrt{gRT}} \qquad (5)$$

which provides for calculating critical pressure for known inlet conditions.

For example, if the inlet pressure is 100 psi abs, inlet velocity is 240 ft per sec, and the corresponding acoustic velocity is 1200 ft per sec, the ratio of the inlet velocity to the acoustic velocity is 0.2 Critical pressure then becomes 0.2 x 100 psi = 20 psi abs. At this pressure the fluid velocity equals the acoustic velocity. Note that this critical pressure is reached only at the end of the pipe in all real piping systems where friction plays a part.

The usual equation of pipe flow can be used to plot a curve, Fig. 3, of pressure against length of pipe. Pressure in the pipe drops as the length increases, as shown by the solid curve *AB*. If the pipe-flow equation is used blindly beyond point *B*, the curve *BC* results, which is physically impossible. In going from *C* to *B* the curve indicates a pressure *rise* with an increase in length, obviously improper. A calculation of the pressure at point *B* shows that the critical pressure has been reached at that point, and the quantitative value can be calculated from equation (5) of this article.

Turbine Drive for 15-Knot Victory Ships



▶ WITH A HULL more streamlined than the Liberty ship, the new Victory type will be at least four knots faster by virtue of an 8500-hp turbine drive instead of the 2500-hp triple-expansion Liberty engine. This Westinghouse turbine-gear assembly has a (1) 5300-rpm 440-psi 740-F high-pressure element exhausting (2) at 30-psi gage through (3) a flexible connection to the (4) 4400-rpm low-pressure element to condenser vacuum (5). The pinions (6) and (7) each drive their own intermediate gears (8) and (9) and through reduction gears (10) and (11) the bull gear (12) and the propeller shaft coupling (13).

With the launching of the first of this type, the United Victory, in January, the 1944 program includes some 400 vessels to follow. They are 455 ft long, have a 62-ft beam and are rated at 10,800 dead-weight tons. Cargo capacity of about 9150 tons closely approximates that of Liberty ships. Shift to the faster Victory type is in line with postwar needs for permanently useful cargo carriers. It is estimated that the increased speed over that of the Liberty will more than double the capacity of a ship plying the North Atlantic run and result in correspondingly faster cargo handling for longer Pacific hauls.

Electro-Pneumatic Control

G W Heumann, industrial-control engineering division of General Electric Co, tells how and where compressed-air-operated contactors are used with rheostatic control when electromagnetic designs become too large. Then their massive parts make them sluggish and the comparatively large coil current subjects control devices to severe service

► VARIABLE-VOLTAGE CONTROL for large motors eliminates the large contactors needed with rheostatic control, but requires a motor-generator set to supply power to the load-driving motor. In some applications, such as traveling machines, motor generators may be objectionable; then it becomes necessary to use rheostatic control with heavy contactors to handle full motor current. Because of their massive magnetic circuits and heavy moving parts, large electromagnetic contactors are sluggish in operation, which has led to compressed-air-operated contactors for certain applications.

Conventional contactors up to 600-amp capacity are developed to a state of perfection that makes them suitable for heavy intermittent-duty drives. A 600-amp continuous-contactor rating corresponds to an 800-amp NEMA intermittent-duty rating. These contactors can, therefore, be used for rheostatic control of intermittent-duty motors up to 225-hp rating at 230 v. Below this rating, selection of rheostatic or variable-voltage control depends on drive characteristics and results desired from the control. For larger motors, variable-voltage control is often selected to avoid the large contactors required with rheostatic control.

Magnetic contactors of 1500-amp rating and above on intermittent-duty drives have these disadvantages:

1. Their size requires large, heavy control panels, often difficult to install in available space.

2. Their massive magnetic circuit makes them sluggish in operation because of slow flux build-up in the magnetic circuit. Weight of the moving parts is so great as to require considerable time for the contactors to close. Conventional 1500-amp magnetic contactors require approximately 0.4 sec to close with full-rated voltage on their coil. With control voltage below rated value, closing time is likely to increase. As a result, the control does not respond promptly to master-switch movement.

3. The coil current of a conventional 1500-amp contactor is 0.5 amp at 230 v, which subjects control-circuit devices, such as master switches and interlocks, to abnormal duty. This is especially true of duplex drives, for which one master switch handles two or more contactor coils. The result is considerable arcing on the master-switch contacts, increased maintenance and shortened contact life.

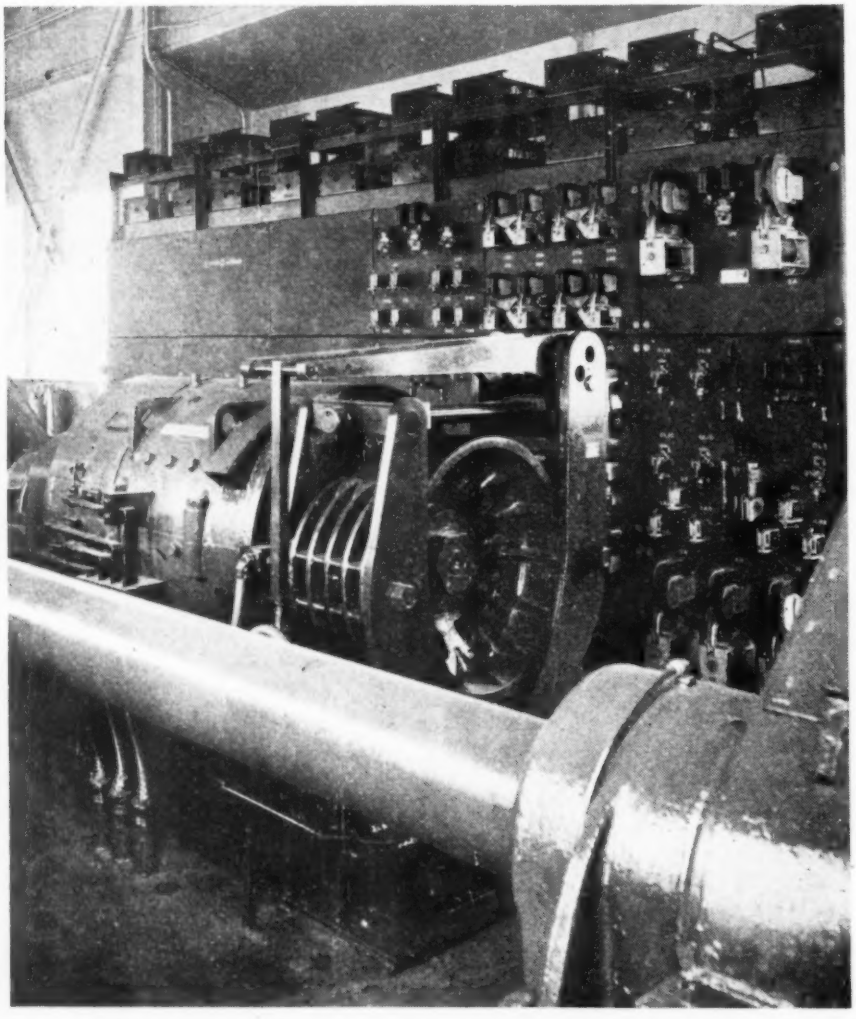


Fig. 1—Interior of machinery house atop traveling car dumper (Fig. 3) with 330-hp dc motor and its brake behind shaft; control panels in right background

Electro-Pneumatic Designs

When large magnetic contactors are objectionable, an electro-pneumatic design may be the solution. Compressed air, controlled by an electrically operated valve, closes such contactors. They have been used widely on railways and marine control, and offer certain advantages for industrial applications, primarily in sizes of 1500 amp and above.

Fig. 2 shows a typical 2500-amp air-operated contactor, with its arc chute removed to expose the contacts and blowout. Its two insulated side members carry the stationary contact. The movable contact, pivoted to the side members, is actuated by an air cylinder, *C*, with an insulated piston. The contacts are surrounded by an arc chute, *A*; a

Speeds Heavy-Contactor Operation

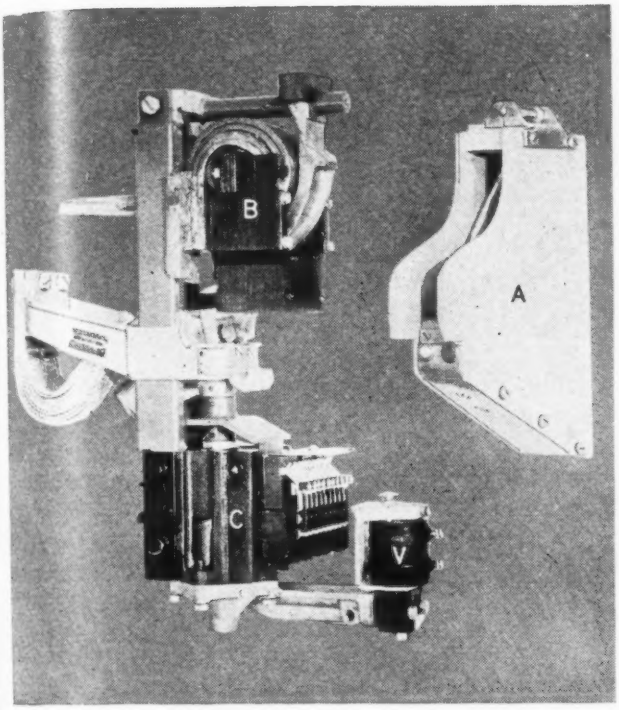


Fig. 2—Compressed-air-operated contactor, rated 2500 amp, with the arc chute removed to show the contacts and blowout

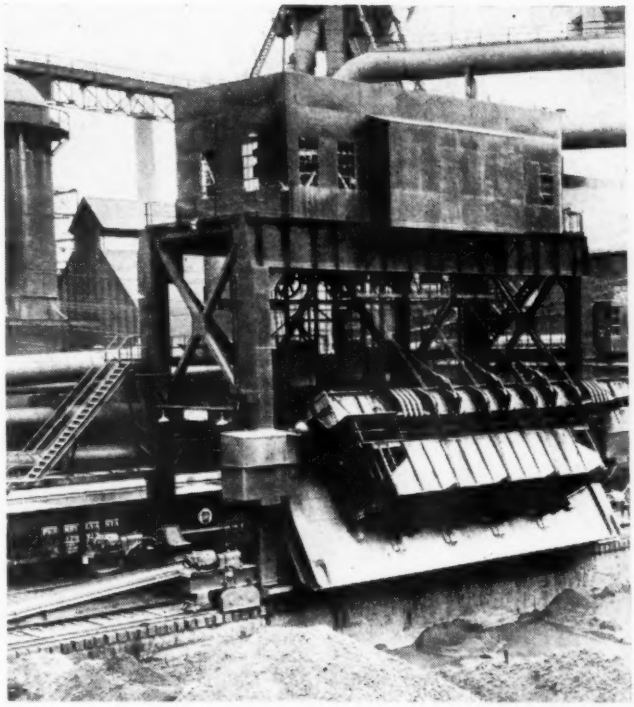


Fig. 3—Cradle hoist of traveling-car dumper, powered by two 330-hp series-wound motors in machinery house above dumper

blowout, *B*, is mounted on the stationary contacts.

A magnet valve, *V*, when energized, admits air to the cylinder and its piston closes the contactor and holds it closed against a spring. Deenergizing the magnet valve cuts off the air supply from the cylinder and the spring opens the contactor.

Inverting the air cylinder makes the contactor into a normally closed design, on which the contacts open by admitting air to the cylinder, and close by spring action. Such spring-closed contactors can be used on emergency dynamic-braking circuits. Pneumatic contactors are operated on a 65- to 90-psi air supply. If the air supply can be regulated to suit the control, adjust the pressure to lowest value that gives satisfactory operation. This reduces maintenance on the air cylinders. When an individual air compressor supplies the control, adjust it to start at 65 and stop at 75 psi, thus maintaining an average pressure of about 70 psi.

Amount of air for operating the control depends on number of contactors and frequency of their operation. For example, on an installation of 26 pneumatic contactors and two 8000 ft-lb air-operated brakes on intermittent-duty material-handling equipment, a 10-cfm compressor was adequate. Air-operated contactors require much smaller space than magnetic contactors of a comparable size. A bank of thirteen 1500-amp contactors, which were grouped in a space 7 ft long, 28 in. high, 24 in. deep, weighed 1770 lb.

Speed of Operation

They respond faster than magnetic contactors of equal size. Normally open, 1500-amp air-operated contactors close consistently within 0.075 sec after closing of the valve-coil circuit, with air pressure between 60 and 80 lb. A normally closed contactor of equal size opened its contacts within 0.1 sec under the same conditions. This indicates consistent contactor-operation speed under fairly wide air-pressure variations. This speed is not influenced by control-voltage variations as long as the voltage is high enough to operate the control valve properly.

At 230 v, the valve coil on pneumatic contactors takes a current of about 0.04 amp. Thus, if five 1500-amp air-operated contactors are controlled by one master switch, its duty is about the same as when controlling one 300-amp magnetic contactor.

When considering the application of air-operated contactors, carefully scrutinize the air supply. Do not install them where the air supply is not continuous and reliable. If necessary, provide against air lines freezing in winter.

Fig. 1 shows an electro-pneumatic rheostatic control for a traveling-car-dumper cradle hoist, installed in the machinery house on top of the dumper. Heating the house during cold weather eliminates possible air-line freezing troubles. This hoist is powered by two 330-hp series-wound motors, each equipped with an 8000-ft-lb air-operated shoe brake. The control of dynamic-braking-lowering design has thirteen 1500-amp contactors for each motor, one of which is spring-closed for emergency dynamic braking.

The panel is constructed as a factory-assembled job with resistors mounted on top and in the rear. First two sections on the right contain the control for the four travel motors, which is the conventional magnetic-contactor type. Next section contains relays and switches for the hoist control. The air-operated contactors are mounted behind the blank panels on the left, a construction chosen because of limited aisle space in front of the panel.

Ammonia Soaks Up the Heat and Carries It Away

What happens to the liquid refrigerant and how it reacts during the process is explained by A B Duryee, Canada Dry Ginger Ale, Inc, in this unusually clear picture of a refrigerating system's internal workings

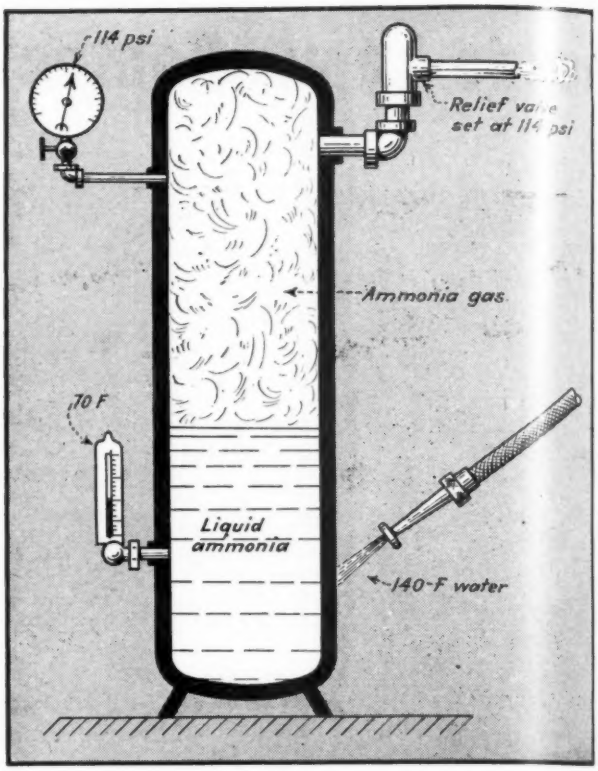


Fig. 1—Adding heat to ammonia under constant pressure boils the liquid away without raising its temperature above that corresponding to the pressure

Q 1—Explain the term, sensible heat, when applied to ammonia.

A—Sensible heat, applied to ammonia (or any other substance) shows up as temperature registered on the ordinary thermometer. The term, used without reference to other factors, simply tells whether ammonia is hot or cold—as we think of these terms in everyday life. It is not a *measure* of total heat or Btu in ammonia.

Q 2—Explain the term, latent heat, when applied to ammonia.

A—Latent heat is the number of Btu that must be applied to and absorbed by ammonia to change it from liquid to gas. If a quantity of liquid ammonia is just at its boiling point (—28 F at atmospheric pressure) each pound must absorb 589.3 Btu before it will change to a gas.

This is not a fixed quantity, but varies with pressure and temperature. For example, liquid ammonia at 70 F, requires 508.6 Btu per lb to change it to a gas. The U. S. Bureau of Standards Circular 142 (*Tables of Thermodynamic Properties of Ammonia*), text books and manufacturers' catalogs contain tables of these characteristics.

Q 3—Why is it that change in a substance's heat content does not always show up as change in temperature?

A—Every substance has a definite boiling point, and when we say "boiling point" we mean the temperature at which the substance changes from liquid to gas. Boiling point changes with pressure. A drum of ammonia at 70 F shows a pressure of 114 psi. If it has previously been stored in a cooler place, boiling takes place until it reaches 70 F and a pressure of 114 psi. Suppose we put a relief valve, set at 114 psi, on this drum and spray hot water over it. The ammonia starts to boil and the gas thus formed escapes through the relief valve which maintains a steady pressure. As long as any liquid remains, its temperature holds at 70 F, all supplied heat being absorbed in changing the liquid to a gas, Fig. 1.

Q 4—What is the specific heat of ammonia? Also, explain how such heat affects the use of this liquid as a refrigerant.

A—Specific heat is actually a ratio, but we use the term to indicate the

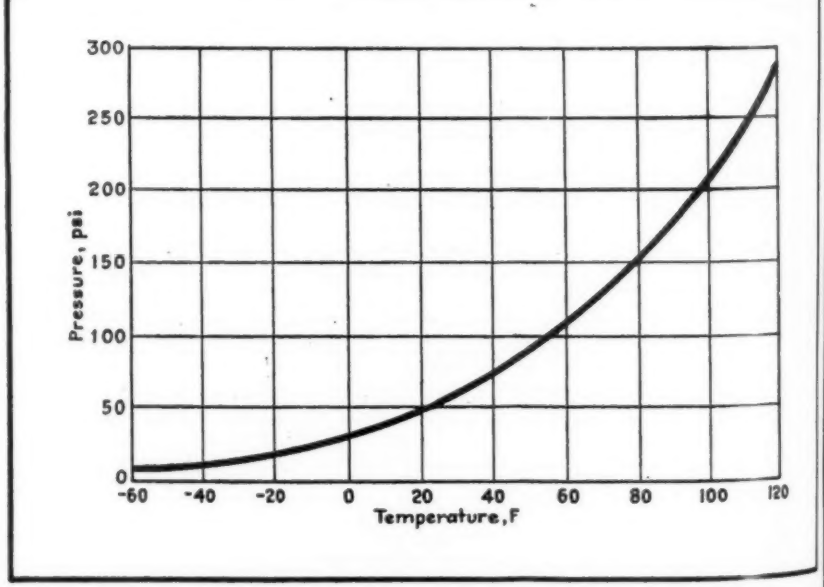


Fig. 2—Ammonia's vapor-pressure temperature characteristics. Its pressure increases slowly at low temperatures but more rapidly at higher temperatures

quantity of heat necessary to raise one pound of a substance one F, or, to lower one pound the same amount. Specific heat varies with temperaure. Generally speaking, when the ratio between latent heat and specific heat of the liquid is large, we have an ideal refrigerant. Liquid ammonia is in this category, its specific heat is 1.129 at 70 F, and that of its gas at constant pressure corresponding to 86 F, is 0.4011.

Ammonia refrigerant serves to convey heat away from some substance that we wish to cool or freeze. Definite characteristics of this substance all have a marked effect on its use.

When liquid ammonia expands from a higher to a lower pressure, in an evaporator coil, we have to remove some of its heat content. For example, if liquid reaches the expansion valve at 96 F and the evaporator coils are at 5 F, the liquid must be cooled to 5 F before it performs any useful work. Temperature difference, 91 F here, multiplied by the specific heat, gives quantity of heat to be removed. This can also be found in ammonia tables.

Q 5—Give a simple explanation of the pressure-temperature relationship of ammonia in a closed cylinder.

A—Pressure of ammonia in a closed cylinder increases with its temperature—slowly at low temperatures, but rapidly at high temperatures, Fig. 2.

Q 6—What is ammonia's critical temperature, and does it affect the operation of a refrigerating plant?

A—Critical temperature is 280 F. At this temperature, latent heat becomes zero, and heat content of the liquid and the vapor are the same. As the pressure at this temperature is well over 1600 psi, it is far above the normal operating range, Fig. 3.

Q 7—What happens to ammonia as it passes through an expansion valve? Is its boiling point changed?

A—When ammonia passes through an expansion valve, it expands because it passes from a higher to a lower pressure. As pressure drops, boiling temperature falls and some or all of the ammonia, depending on conditions, changes from liquid to gas.

Q 8—What happens to ammonia in the evaporator coils?

A—Ammonia in the evaporator coil boils and does work of refrigeration. Actually, what happens is this: Assume that condensing pressure—gage pressure of liquid going to the coils—is 185 psi, and that evaporator-coil pressure is 20 psi. Referring to ammonia tables we find: (a) heat content of the liquid at 185 psi (199.7 abs) is 150.5 Btu per lb, (b) heat content of the liquid at 20 psi (34.7 abs) is 48.9 Btu per lb.

Then, heat removed to cool liquid to 5.5 F (20 psi) before doing work, is 150.5—48.9=101.6 Btu per lb. Since latent heat at 20 psi is 564.6 Btu per lb, and heat removed to cool the liquid is 101.6 Btu per lb, the heat-absorption ability left to do work is 463.0 Btu per lb.

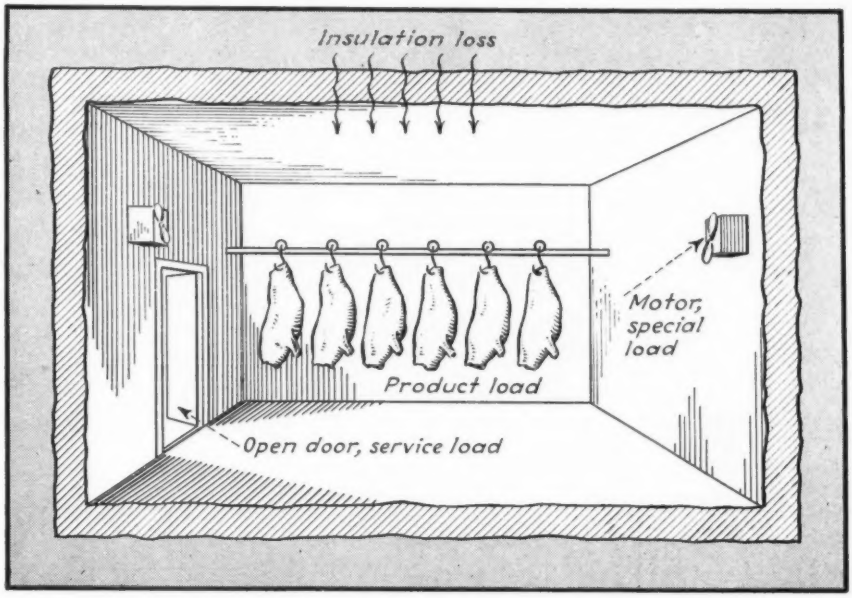


Fig. 4—Quantity of heat to be removed from cooling room depends on insulation loss, open doors, special heat producers—motors and lights, and product load

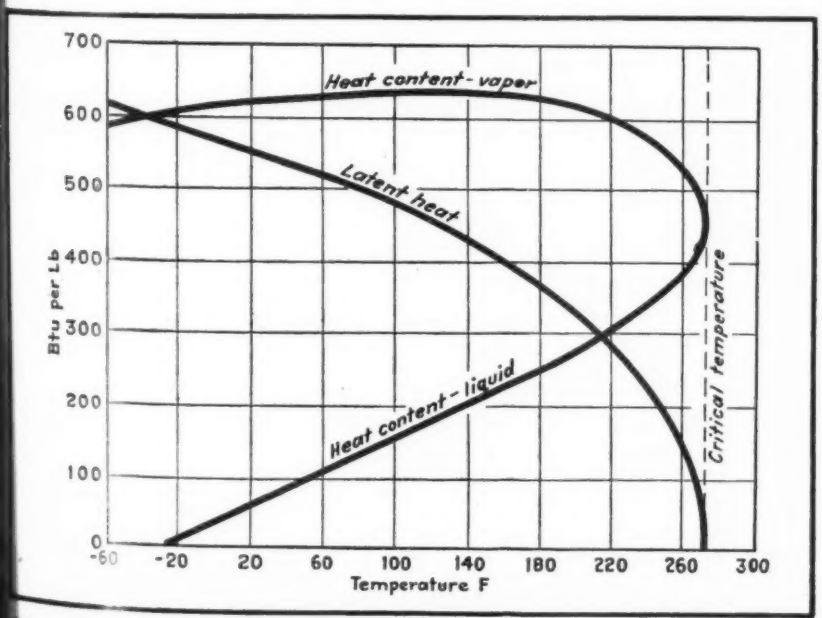


Fig. 3—Latent heat of vaporization and heat content of saturated ammonia vapor and liquid. Heat content of vapor and liquid is equal at critical temperature

Q 9—What does superheat mean, and what causes ammonia to become superheated in the evaporator coils?

A—As previously explained, pressure and temperature of saturated ammonia have a definite relationship. Referring to Question 8, the temperature corresponding to a pressure of 20 psi is 5.5 F. This should be the gas temperature as it leaves the evaporator coils. However, a thermometer in the discharge line may show a temperature of 8 or 10 F. The difference is superheat. If we could remove the gas as soon as formed, giving it no opportunity to remain in the coils, we would not have superheat at this point. Refrigerating coil designers

have been striving to accomplish this but it is practically impossible to eliminate superheat entirely. A poorly insulated suction line also helps superheat the gas.

Q 10—What changes in ammonia heat and pressure occur in the compressor?

A—The compressor does work on the ammonia which raises its temperature, heat content and pressure. Main purpose is to raise refrigerant's boiling point to the temperature at which the cooling water can condense the gas to a liquid so that it can be used over again in the evaporator.

Work Done by Compressor

Assume the same conditions mentioned in Question 8, namely, condensing pressure 185 psi, and evaporating pressure 20 psi. Work done by the compressor per pound of ammonia circulated, expressed in Btu, can be found in the Bureau of Standards' tables, and is the increase in heat content between compressor inlet and outlet.

When using this reference to solve the problem read, from Table 1 for 35 psi abs, vapor heat content 613.5 Btu and also entropy 1.324. Since the vapor is superheated by the compressor, we enter Table 5 and, in the column under 200 psi abs, find the entropy figure nearest to 1.324. Next column to the left gives the heat content and by interpolation we get 725 Btu. Then 725−613.5= 111.5 Btu per lb added by the compressor.

Q 11—How do you determine the amount of ammonia that must be circulated per ton of refrigeration?

A—First, find how much work or refrigerating effect we can expect from each pound of ammonia. This is the difference between the heat content of saturated liquid at condenser pressure and saturated vapor at suction pressure. It can also be expressed as the difference between the quantity of heat removed by the condenser water and the work done by the compressor. Take the conditions in Question 10 and again use the tables.

Heat of the saturated liquid at 185 psi (200 psi abs) is 150.5 Btu, and heat of the saturated vapor at 20 psi (34.7 psi abs) is 613.5 Btu. The difference is 462.6 Btu and each pound of circulating ammonia removes that much heat at under these conditions. Now, a ton of refrigeration is defined as the transfer of 200 Btu per minute, or 12,000 Btu per hour. Therefore, 200÷462.6=0.432 lb of ammonia per minute for each ton of refrigeration required to do this particular job.

Q 12—How do you determine number of Btu's that must be removed from a cooling space?

A—Quantity of heat that must be removed from a cooling place depends upon: 1—insulating-loss load (heat loss through insulated walls, floor and ceiling), 2—service load (heat admitted when doors are opened), 3—special loads (heat added by apparatus, such as motors and lamps), 4—product load (heat added by the product to be cooled), 5—temperature surrounding outside surface of the space.

Assume we wish to store beef at 35 F in a room 10×20×10 ft with walls of 4-in. cork board, Fig. 4. Surrounding temperature reaches a maximum of 90 F in summer.

1. *Calculate insulation loss:*

Outside area in sq ft x heat transmission factor x temperature difference= Btu per hr.

Area=10x10x2=200 sq ft
20x10x2=400 sq ft
10x20x2=400 sq ft

Total 1000 sq ft

Then 1000x0.07 (4-in. cork board) (90−35)=3,850 Btu per hr.

2. *Service load:* Heat admitted through doors depends, of course, on how frequently they are opened. Assum

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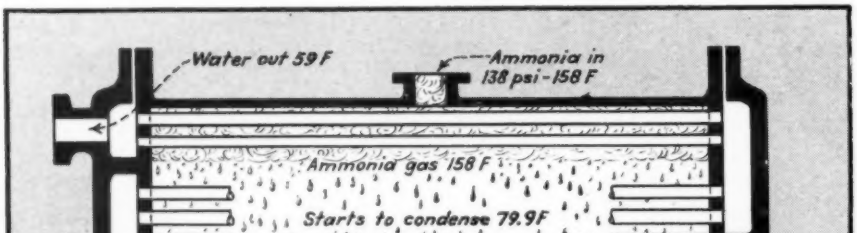


Fig. 5—Ammonia gas coming into a condenser gets cooled to condensing temperature, condensation then progresses and final cooling occurs in the liquid itself

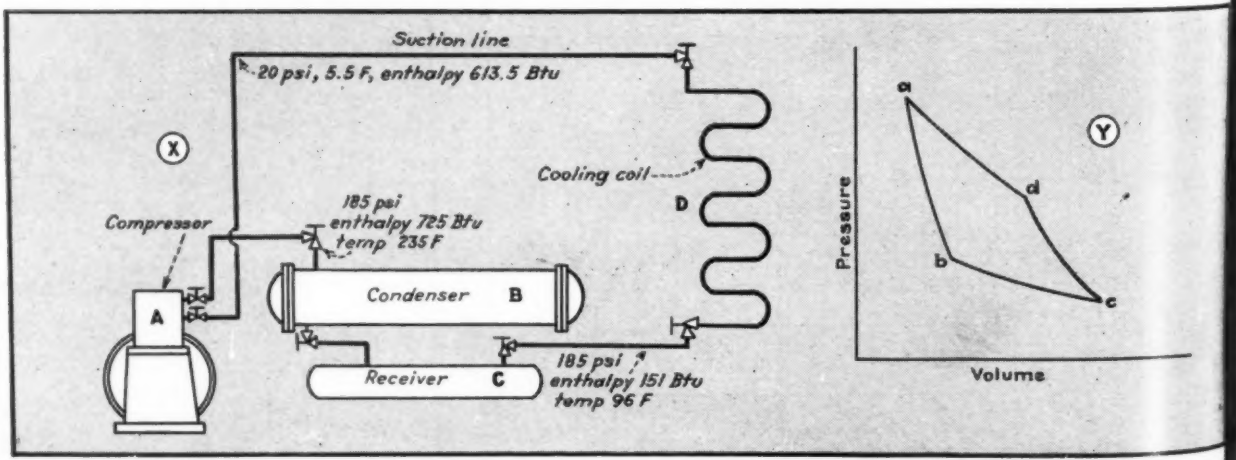


Fig. 6—Temperature, pressure and enthalpy figures on the piping diagram denote action on ammonia as it passes through the system. Y—Graphic lines show pressure and volume changes on the refrigerant during its journey through the system

How to Keep Your Diesel on Its Toes

To get every ounce of performance built into your engines, let modern instruments reveal what's going on in the cylinders. Here's basic data on the indicator, granddad of them all

▶INSIDE A DIESEL CYLINDER the entire power-generation cycle takes place. Fuel burns, gas expands, chemical energy becomes heat energy and then mechanical energy. Small wonder that the key to efficient engine performance lies hidden under the cylinder head and that engineers exercise all their ingenuity to devise practical means for revealing what goes on as the piston rises and falls, valves open and close, and injectors spray minutely measured jets of fuel.

When all these actions coordinate perfectly, hundreds of times each minute, the diesel engine gives the performance that makes it the most efficient prime mover. Let compression pressure fall too low, valves open too soon, fuel inject too late—performance falls off. If each part of the cycle in the cylinder could be studied and compared with the ideal, finding the source of trouble would offer no difficulties. In everyday operation such study proves impossible so the operator must turn to the clues offered by a number of different devices.

Oldest tool in the trouble-shooting kit is the indicator pioneered by James Watt. Although probably the best all-round device for diagnosing diesel troubles, tougher service conditions in this field make it less used than on the steam engines for which it was originally designed. Modern devices show maximum and compression pressures, or pre-exhaust pressure; these readings do not tell the whole story but as part of an easy and convenient operating routine they do spot most of the common troubles.

In addition to cylinder pressures at various stages of the cycle, observation of exhaust conditions tells the intelligent operator much about the operation of his engines. To aid in these observations he uses the exhaust pyrometer, the smokemeter and various kinds of gas analyzers.

This article, and several to follow, covers the various types of indicators—how they work, how to use them successfully and how to apply the results practically. Later articles will deal with equipment for diagnosing troubles from changes in exhaust conditions.

Basic Indicator Idea

Fig. 1 shows the basic idea of an engine indicator. Schematically, it consists of a board sliding in a frame, *B*, and so connected by cord *O* that it moves with the piston. Gas from the engine cylinder enters indicator cylinder *D*, pushing piston *P* outward until compression of spring *S* balances cylinder pressure. When cylinder pressure drops, pressure in the indicator cylinder drops also and the spring pushes the piston inward until pressures again balance. The piston rod carries a pencil point at the end, which marks a sheet of paper carried on the board.

When the piston starts down on the inlet stroke, the pencil point is at *F* and cylinder pressure is close to atmospheric. As the piston moves down, the board moves up and the pencil traces line *FA*. With the inlet valve closed the piston rises and the board moves down. During this stroke, cylinder pressure increases as the air trapped in the cylinder is compressed, and the indicator piston moves to the right. Thus the pencil traces the line *AB*. Before the piston starts down again, fuel sprays into the cylinder, and ignites. Cylinder pressure rises and the pencil moves to *C*; as the expanding gas pushes the piston down, the pressure falls and the pencil traces the curve *CE*. At *E* the exhaust valve opens and pressure drops sharply to approximately atmospheric, *A*. The piston again reverses its travel, pushing out the burned gas and the pencil moves back along *AF* to *F* where the cycle begins again.

This crude indicator has traced out a graphical representation of the cylinder events that has many uses. Note that because the board moves in a constant

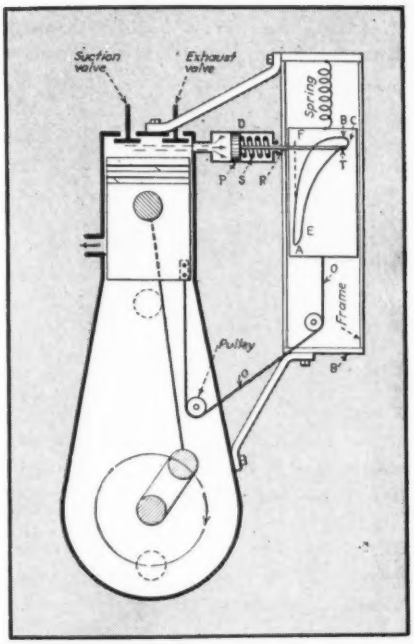


Fig. 1—Basic indicator principles

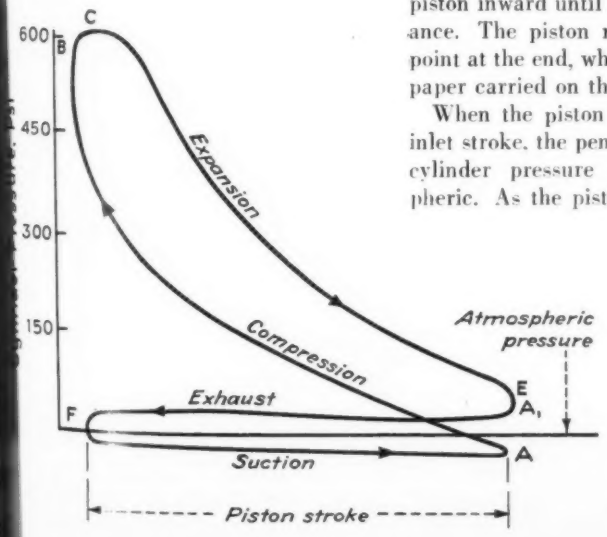


Fig. 2—Theoretical indicator diagram shows cycle of events in a 4-stroke diesel. In an actual diagram, such as Fig. 5, top, exhaust and inlet pressures are so close to atmospheric pressure that they show as a single straight line across the card

relation to the piston stroke, vertical distances on the *card*, or *indicator diagram*, represent piston movement *to scale*. Likewise, the motion of the piston rod is proportional to the cylinder pressure. If the strength of the spring is known, the pressure can be figured from the card. For example, assume a 200-psi spring—that is, a spring that will be compressed 1 in. if 200 psi is applied to the piston. If point *B* is 2¼ in. above the atmospheric line *FA*, then compression pressure rises to 450 psi.

Theoretical Diagram

Fig. 2 shows the cycle events more clearly but it is a *theoretical* diagram. Note that on the suction stroke *(FA)*, pressure is clearly below atmospheric and that during the exhaust stroke*(A,F)* it is clearly above. If this were not so, air would not flow into the cylinder and burned gas would not flow out. But in an actual diagram, drawn to scale as just described, the pressure differences are so small that intake and exhaust seem to follow a single line at approximately atmospheric pressure.

Indicator diagrams from 2-cycle diesels do not show exhaust line *AF* because all the exhaust action occurs from *E* to *A*; nor does the suction line *FA* appear, because the 2-cycle engine has no suction stroke.

Watt's original indicator had no recording device; John Southern, his assistant, added the pencil and sliding board some years later (1796). In the late 1820's, Mc Naught substituted an oscillating drum for the sliding board, making the instrument more compact and convenient, and more suitable for higher speeds. In 1863, C B Richards, an American, devised the straight-line magnifying gear for the piston motion and in the 1870's two other Americans, Thompson and Crosby, introduced further improvements.

Higher temperatures and speeds of steam engines and advent of gas and oil engines, with high cylinder pressures and temperatures, led to development of modern designs with the spring outside where it is unaffected by temperature, and with inertia of moving parts reduced to a minimum for distortion-free operation at high speeds.

Fig. 3 shows a semisectional view of a typical modern indicator suitable for high-speed steam engines and slow- or medium-speed diesels. The unit connects to the cylinder by the wingnut union; cylinder pressure acts on the piston against a double-coil tension spring above. The piston rod connects to a forked recorder arm by means of a linkage that gives a magnified straight-line motion at the drum. Maximum stylus travel is 2 in.; a stop arrests upward travel of the piston when top position in reached. Such indicators can be fitted with a range of piston sizes and spring strengths to meet the various maximum pressures encountered in steam-engine, compressor, gas-engine or diesel work. It is good practice to use the largest piston and stiffest spring capable of producing a diagram large enough to be measured and studied satisfactorily.

High-Speed Indicator

For indicating engines operating at higher speeds, the different design of Fig. 4 is employed. Note that the spring is a cylindrical, tapering cantilever beam, with its base in the indicator frame and its tip at the piston. If a coil spring were used, its natural frequency

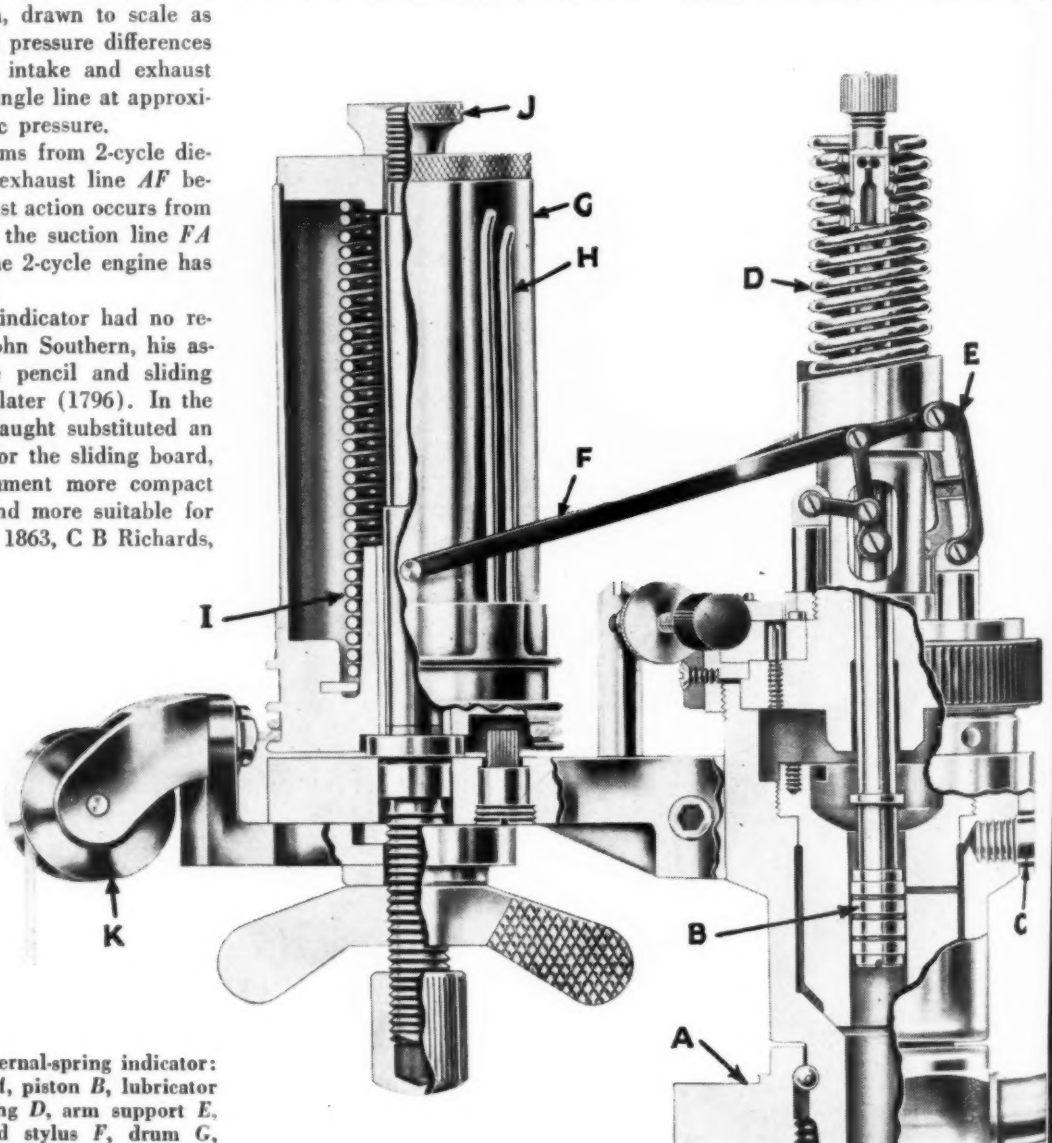
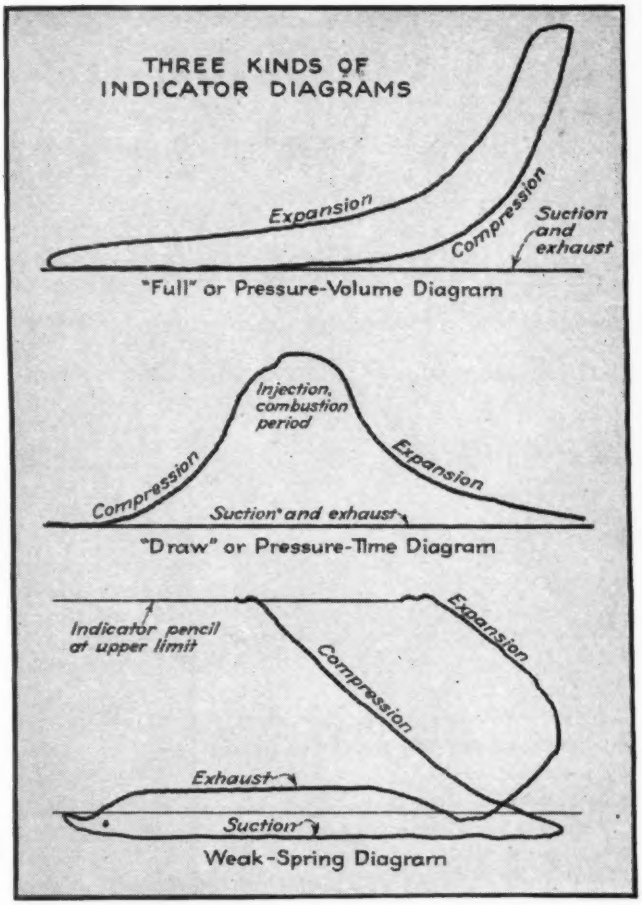


Fig. 3—Typical external-spring indicator: union connection *A*, piston *B*, lubricator connection *C*, spring *D*, arm support *E*, recording arm and stylus *F*, drum *G*, clips for card clip *H*, drum spring *I*, adjustment for drum-spring tension *J*, and guide pulley for indicator cord *K*

Fig. 4—Indicator for higher speeds has cantilever-beam spring, with heavy end fastened in frame at right and tapered tip acting against piston. Chronomatic drum rotates at set speed for making pressure-time cards. Fig. 5—Various card types



of vibration would run lower than the engine speed, which would result in oscillations on the diagram. The beam spring has a high natural frequency, above the speed range of the engine. Maximum spring deflection and piston movement is small; the straight-line recording motion magnifies this eight times to make a card about 1 in. high. Holding down size, weight and movement of the various parts reduces inertia which is a major problem in high-speed indication. For the speeds encountered in automotive work, for example, electrical and optical devices usually replace mechanical indicators.

Indicator Card Types

So much for types of indicators available. What does the indicator card tell about the operation of an engine? The *full* or *pressure-volume* diagram, Fig. 1 and top of Fig. 5, reveals horsepower output of the cylinder, mean effective pressure, combustion and compression pressures; and comparison with diagrams representing good operation reveals erratic combustion conditions and other hard-to-spot troubles. A later article will show, in detail, how to figure horsepower and pressures and how to use cards in trouble-shooting.

The pressure-volume diagram is the original and best-known type, but every engineer should know two other diagram forms which are particularly useful in checking engine condition and making operating adjustments. The *draw* or *pressure-time* card results when the drum is disconnected from the piston and the cord is pulled by hand. The drum then turns at more or less constant speed and in one direction, instead of oscillating as when it is connected to the piston.

The pressure-time diagram tends to pull out the parts of the cycle where combustion occurs. With a regular indicator hookup, combustion events, taking place near the end of one stroke and the beginning of the next, are crowded into a small space on the diagram, because the piston moves slowly. When the drum turns at nearly constant speed the combustion action shows much more clearly, a useful feature for checking injector performance and other factors affecting combustion. The indicator of Fig. 4 carries a *chronomatic* drum, which rotates at a selected constant speed, eliminating need for manual turning when taking pressure-time cards and insuring greater accuracy.

Still another highly useful form of indicator diagram is the *weak-spring* card. As previously mentioned, the difference in pressure between suction and exhaust fails to appear on an ordinary diagram because the spring may require in the neighborhood of 200-psi pressure change to produce a 1-in. movement on the card. Naturally, pressure differences of a few psi cause little or no movement. To separate the suction and exhaust lines, and thus to spot irregularities in the valve action which would show up in this part of the diagram, substitute a weak spring for the usual high-compression spring.

Weak-Spring Diagram

Fig. 5 shows a typical weak-spring diagram. The suction line runs clearly below the atmospheric line. When compression starts, the pressure rise causes the pencil to hit the stop quickly. From part way up on the compression stroke to most of the way down on the power stroke, the pencil draws a horizontal line at the top of the card. Coming close to the point on the power stroke where the exhaust valve opens, the pencil starts to move down again, tracing the action as pressure drops slightly below atmospheric and then rises slightly for most of the exhaust stroke.

Choosing the Right Governor Isn't an Arbitrary Affair

You don't use a micrometer to measure a garden so it is equally poor engineering to use a fluid or strap governor on a machine that does not require highly accurate speed regulation. A F Schwendner, Westinghouse Elec & Mfg Co, describes improved turbine-control methods

► Once a governor's characteristics are known, some but not all of its objectionable features may be eliminated. Most mechanisms employ a speed changer, whose design determines some of these characteristics. Fig. 1*A* illustrates a speed changer that acts through a secondary spring, *X*. Main feature is that the weights have to be moved to change the governing valves to a different flow position while maintaining the same turbine speed. That is why it is called a travel governor.

Thus, the speed-governor-travel curve is distorted, which affects the incremental regulation curve regardless of the kind of governor valve. Also, the speed changer's position affects speed regulation. Since most distortion comes from moving the governor weights, why move them? If we do not, the governor is a non-travel unit, Fig. 1*B*. Its speed changer does not change governor-weight position as long as the unit runs at normal speed. Using the governor collar as a fulcrum, speed changer moves the valve-position-lever center to obtain different valve positions with one identical governor-weight position.

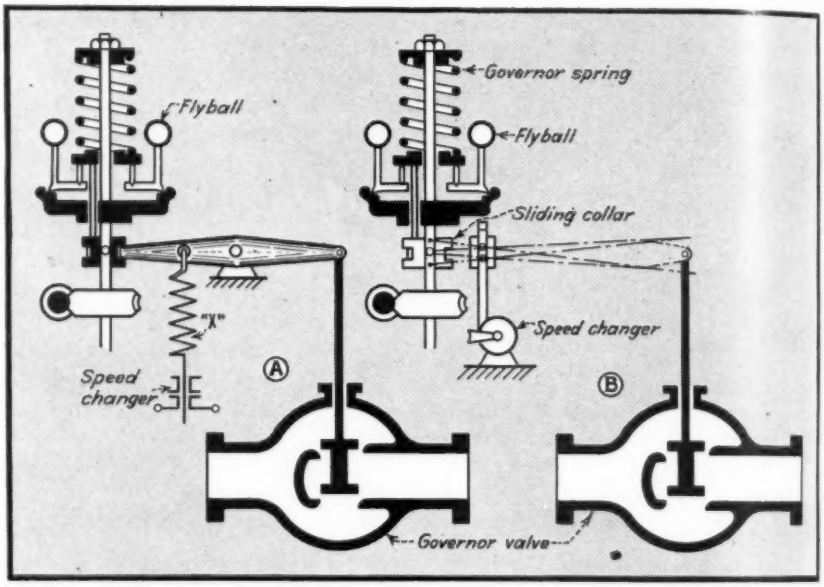


Fig. 1—(*A*) Speed changer acting through secondary spring moves governor weights to change valve position. (*B*) Collar serves as fulcrum; weights do not move

Speed-Travel Relation

How this scheme affects the governor's characteristics is shown by Fig. 2. This system has the advantage of the same speed-travel relationship at all loads since position of the governor does not change. The requirements—that it open the governing valves fully from no-load position, because of speed change, without changing the speed-changer setting and also drop full load and close the valves from the maximum load rated-speed position—take a considerable amount of governor travel. The speed change above and below rated speed also requires travel, and so this governor must have accurate travel setting to obtain the specified speed range. Thus, with a little change on the speed changer, we improve performance of the complete unit considerably.

Since the governor rarely can be mounted convenient to the valve, designers began to use more mechanical linkages to transmit motion over greater distances, and every addition increased the over-all friction. To banish this, they used ball bearings at all joints and devised mechanical oscillators to keep the system moving ever so slightly, thus substituting kinetic for static friction. But whether static or kinetic, friction still remains a bugaboo in these flyball governors.

While these changes were going on, turbines were growing up and using bigger valves that required larger governor forces. Yet there was no way to increase the flyball governor's power output directly, except to increase its size. Considering that a modern turbine of medium size requires a valve-operating force of perhaps 5000 lb, it is not difficult to see that increasing governor size reaches a practical limit.

Turbine engineers got around this difficulty in the flyball governor by using its relatively small mechanical output to drive an amplifier, which in turn controls an external energy source for force magnification. Fig. 3*A*. The power-magnifier system consists of a relay controlling the admission of h-p oil to move the operating piston of a servomotor in line with governor motion.

Amplifying Problems

An extended mechanical linkage between the governor and servomotor relay required more lag in the governor position than good operation permits. One stage of amplification was not sufficient, but it is relatively simple to add stages as needed.

Since mechanical linkage between the governor and admission valve requires supports that always increase the friction that the governor has to overcome, the amplifying system adopted not only increases the available force

but it also transmits the force from governor to servomotor without additional mechanical connections. The system then consists of a governor and a transformer, or device, that translates movement into a change of hydraulic pressure. Fig. 3*B*.

Pressure change then acts on the amplifier which, using one of the oldest hydraulic principles, magnifies the pressure change by a given ratio. Consider two pistons in a closed hydraulic system, Fig. 3*C*: one piston has a cross-sectional area of 1 sq in., the other, 5 sq in. If a push of one lb is exerted on the 1-sq-in. piston, the liquid pushes against the larger piston with a force of 5 lb, or the force is amplified five times. The actual amplifier does not work quite this way, but the principle is the same.

Servomotor Moves Valve

The servomotor is nothing more than a piston connected to the turbine governing valve, free to move in either direction. Fig. 3*D*. A decrease in pressure output of the governor-operated amplifier moves the servomotor one way, and an increase moves it the other.

Now what has been accomplished? A little power has been transformed into a lot, and mechanical-linkage oscillators are no longer necessary. And since only a little power is needed to actuate the hydraulic system, the governor itself can be made small, light and relatively free of friction. We're going places!

But some friction still remains in the system. Westinghouse engineers went back to the speed-sensitive element itself, and substituted a metal strap carrying centrifugal weights for the flyballs and sliding collar, Fig. 4*A*. In principle, the two devices are identical except that the strap governor produces forces entirely by an elastic change, hence is frictionless. The strap governor also produces forces without motion (maximum motion 0.005) and so eliminates errors from different valve travels at different governor positions for the same speed change. The transformer, Fig. 3*B* and 3*D*, in combination with its governor, is a travel unit with all the travel-flow distortion and changes in governor-speed regulation inherent in this type. On the other hand, Fig. 4*A* is a nontravel mechanism giving improved governor performance.

First the governor was entirely mechanical, then hybrid mechanical hydraulic. Why not completely hydraulic? Simple. A pump driven by the turbine shaft becomes the sensitive element, and its output pressure is proportional to the square of the shaft speed. Change in pressure then operates a relay and the rest of the amplification system as before, Fig. 4*B*.

Excepting fluid viscosity, the entire system has now become almost frictionless. Complex mechanical linkages and gear drives have been banished, and there is almost nothing to wear out or require periodic inspection. Since speed response depends not upon hydraulic flow but upon a change of hydraulic pressure, the governor can be made to respond to extremely small speed changes.

Pump on Turbine Shaft

Any pump driven by the turbine shaft may be employed as a sensitive speed-responsive element, provided its discharge is not affected by any impulse except speed. But all pump discharges are influenced by suction-pressure changes and other possible errors. A governor pump otherwise known as an impeller was developed, Fig. 5. Suction effect is overcome by supplying the pump with high-pressure oil and the effect of other disturbing factors is reduced so that their influence is negligible.

The impeller consists of a hollow chamber in the shaft, *a*, connected to a drain chamber by properly dimensioned discharge openings, *b*. A series of pumping nozzles, *c*, placed radially in

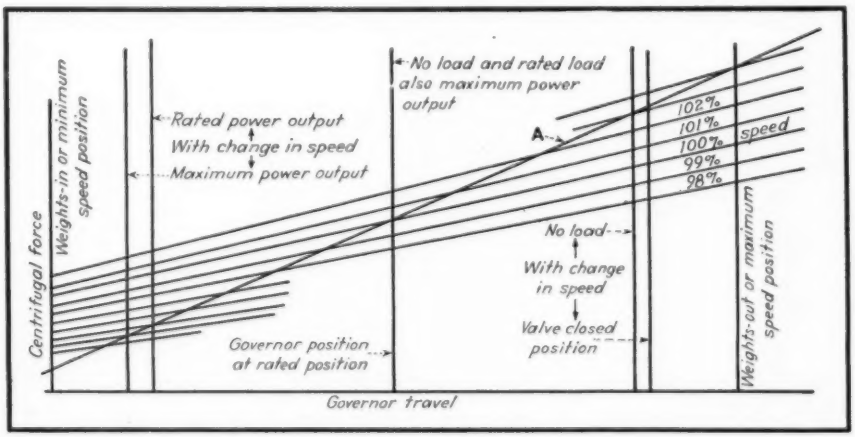


Fig. 2, ***above*****—Characteristics when employing speed changer, Fig. 1*B*. As governor position does not change, it has same speed-travel relation at all loads**

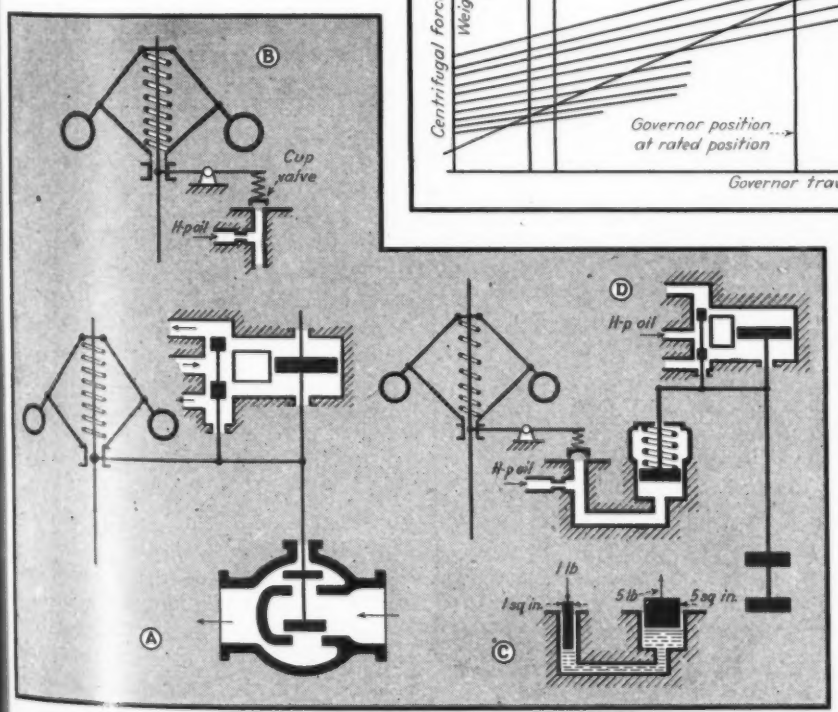


Fig. 3, ***left*****—(*A*) Flyball's small power output moves amplifier piston controlling an output power supply. (*B*) Introduction of additional amplifier. (*D*) Servomotor furnishes power to move valves**

In the second of two articles, Mr Schwendner explains different speed-changer hookups and power-amplifying mechanisms. The first article appeared in Jan, 1944, page 84

the shaft, receive oil through an orifice, *d*, from a higher pressure source than their discharge pressure at maximum speed. An annular seal, *e*, surrounds the shaft chamber so that each nozzle connects constantly to the h-p source.

With the turbine at rest, high-pressure oil from the orifice flows through the nozzles into hollow-shaft chamber and out the discharge openings and no pressure is applied to the power-amplifying system, *f*.

Action of Pump

As turbine shaft rotates, centrifugal action begins to retard oil flow through the nozzles, and pressure builds up in passage *f*, leading to power amplifier. Pressure generated in the nozzles by centrifugal force and that applied to the amplifier system depends on turbine speed. Since this pressure is always less at normal speed than the orifice pressure, a small amount of oil always flows from orifice, through the nozzles to chamber *a* and out the discharge openings, *b*.

Strap and fluid governors are essentially non-travel governors. The hydraulic pressure and power amplifiers used beyond the cup valve are identical for both. Quite often the pressure and power amplifiers are built in separate mechanisms and can be used with either governor. It may seem that these two types of governors should be universally applied. Both have everything—low maintenance, high sensitivity and versatility. But no one would use a micrometer to measure a garden plot, so it would be equally poor engineering judgment to use a fluid or strap governor on a machine that does not require accurate speed regulation.

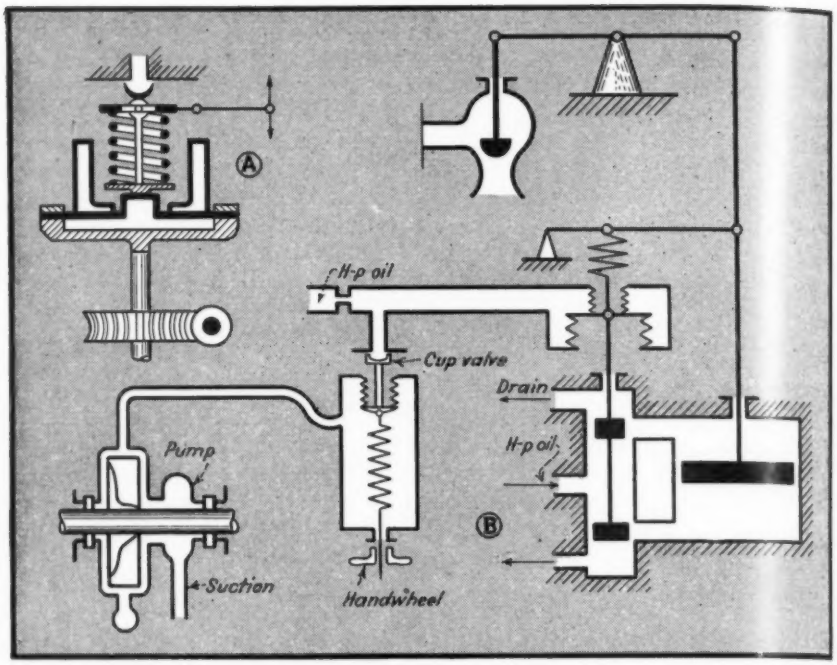


Fig. 4—(*A*) Metal strap and weights provide a frictionless governor head. (*B*) Pump governor operates cup pilot valve to control flow of high-pressure governor oil

Consequently, current design embraces four kinds of governors, varying in cost and performance: 1—flyball governor with or without hydraulic-power amplifications; 2—gear-orifice governor with or without power amplification. (In sensitivity and power this unit matches the performance of the first, but in addition can be used for a wide speed range; 3 to 1.); 3—elastic-strap governor with hydraulic pressure and power amplification; 4—fluid governor with pressure and power amplification.

Applications overlap somewhat because with hydraulic power and pressure amplification an elastic-strap governor can do any speed-regulating job as well as the fluid governor. For precise regulation either of these systems can be used because their sensitivity, rate of response and maintenance characteristics are almost identical.

The fluid governor with large-capacity oil pump on turbine shaft furnishes the large instantaneous oil demand required for fast servomotor operation. It also permits the oil reservoir to be quite a distance from the unit in a fireproof room, and it does not need a vertical shaft and gear drive. With its more flexible arrangements, this governor is exceptionally suited to large-turbine application. On the other hand, the strap governor serves ideally for small units of low oil requirements with attached oil reservoirs.

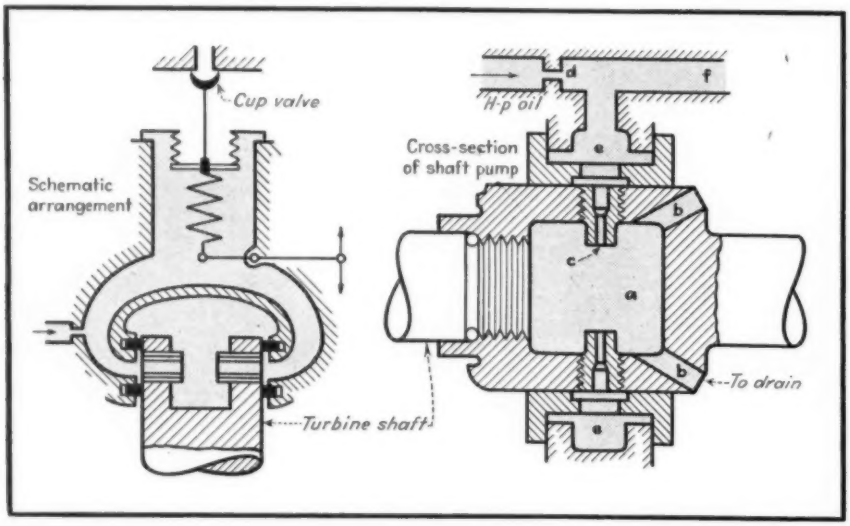


Fig. 5—Pump governor constructed as an integral part of turbine shaft eliminates friction usually present in the moving gears and levers of mechanical drive

Meet Exacting Demands

The two latter governors have built-in performance characteristics that meet the most exacting demands for sensitivity and rate of response. Since they respond to minute speed variations almost instantaneously, other unit governors in the same station must be brought up to reasonably close performance. The more sensitive governor picks up load or drops it quickly, while a parallel turbine controlled by an insensitive governor may not be influenced at all by the same frequency swing.

Another factor to consider when analyzing governor performance is the relative generating capacities of units

operating in parallel. Fig. 6 shows what happens to the frequency when a 1000-kw and a 300-kw unit operate in parallel or alone. Assuming that both are identical and set for 4% speed regulation, dot-and-dash line shows that, when operating in parallel, a 100-kw load variation changes the system speed 0.3%, *a*. If each unit runs alone, a 100-kw load variation on the large machine changes the system speed 0.4%, *b*, while the smaller unit allows the speed to vary 1.34%, *c*, for the same load change.

Effect of Speed Change

If the speed change must be identical on both machines for the same load change, the smaller unit's regulation must be reduced to about 1.2%, dot-dot-dash line, where a 100-kw load variation changes the speed 0.4%, *b*. This low regulation may not be stable and if both units operate in parallel, the smaller unit will completely load or unload with a 600-kw load change on the system. Both governors, when set at 4% speed regulation, pick up load in proportion to their capacity.

Choosing the right governor cannot be arbitrary; turbine size, speed regulation and type of load must all be weighed and judged in their relation to each other to obtain the best governor performance characteristics. Each governor unit must be selected to fit the job.

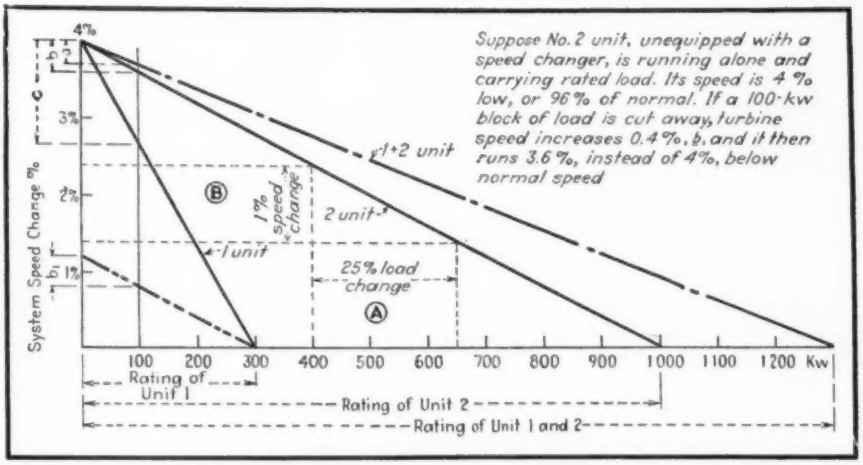

Suppose No. 2 unit, unequipped with a speed changer, is running alone and carrying rated load. Its speed is 4% low, or 96% of normal. If a 100-kw block of load is cut away, turbine speed increases 0.4%, b, and it then runs 3.6%, instead of 4%, below normal speed
System Speed Change %
4%
3%
2%
1%
1+2 unit
2 unit
1 unit
1% speed change
25% load change
100 200 300 400 500 600 700 800 900 1000 1100 1200 Kw
Rating of Unit 1
Rating of Unit 2
Rating of Unit 1 and 2

Fig 6—A governor with 4% regulation allows turbine speed to fall 4% from no load to rated load. For example: If load on one machine changes 25% of rated load in either direction, *A*, turbine speed will change 25% of 4% or 1%, *B*

New Metals Forecast Postwar Changes

▶ OUR EXPANDING AIRPLANE INDUSTRY emphasizes possibilities in lightweight materials that are bound to be reflected in everyday products. We may, indeed, look forward to a "light-weight age," influencing design of everything from beds, now too heavy for a housewife to lift, to turbine generators. In the electrical industry's early days, cast iron was used liberally—even for transformer tanks. Holdovers from the idea of favoring weight in design still exist. As the pendulum swings the other way, we will more and more be penalized because equipment is not light enough, or holds too much oil, or requires expensive local handling facilities.

One newly developed material, *Hipersil* (high permeability silicon iron) is producing impressive results in reducing weight. For years, scientists have discussed theories of the magnetic properties of iron and its alloys. Grain orientation effects have long been known, but until recently could not be controlled in manufacture. In the early 1930's, continuous efforts towards an improved magnetic steel resulted in perfecting, on a laboratory scale, an orientation process which, combined with steel-making developments, finally gave an oriented product that could be produced in quantities.

To illustrate, consider a circular disk of magnetic iron. With ordinary, random-oriented iron, magnetic properties would be uniform in all directions, but that is not true with a disk of Hipersil when it is placed in a magnetic field. The disk exhibits distinct directional effects as though it were a rectangular instead of a circular piece of iron. With ordinary random-oriented iron, it would stay in any angular position.

The earth's field can set up enough flux in strips of the new iron to produce pronounced magnetic sticking effects. Reversing one strip produces the same effect, showing that no permanent magnetism is present. With the strips at right angles to the field no sticking action takes place. Strips of random-oriented iron of conventional type do not have sufficient flux produced by the earth's field to cause their ends to stick together.

Because its grains are oriented in a longitudinal direction, the new iron can carry up to a third more flux than conventional random-oriented iron. This has made much smaller and lighter transformers possible.

Back of the initial production and the reduction to practice of an entirely new material like this are problems such as changing over a factory to new methods of making transformers. The new material has high cost, because of small-volume production. Every time a new material is introduced on a large scale, large financial risks have to be taken, or the vicious circle of low-volume-equals-high-cost results in a stalemate.

An outstanding characteristic of research and development work is that, starting in one direction, one develops unexpected but important offshoots in other directions. Hypersil, for instance, had just got into production for the electrical industry when military demands for light-weight equipment arose. Now, it finds great use in military electronic equipment—from pack sets to airborne devices.

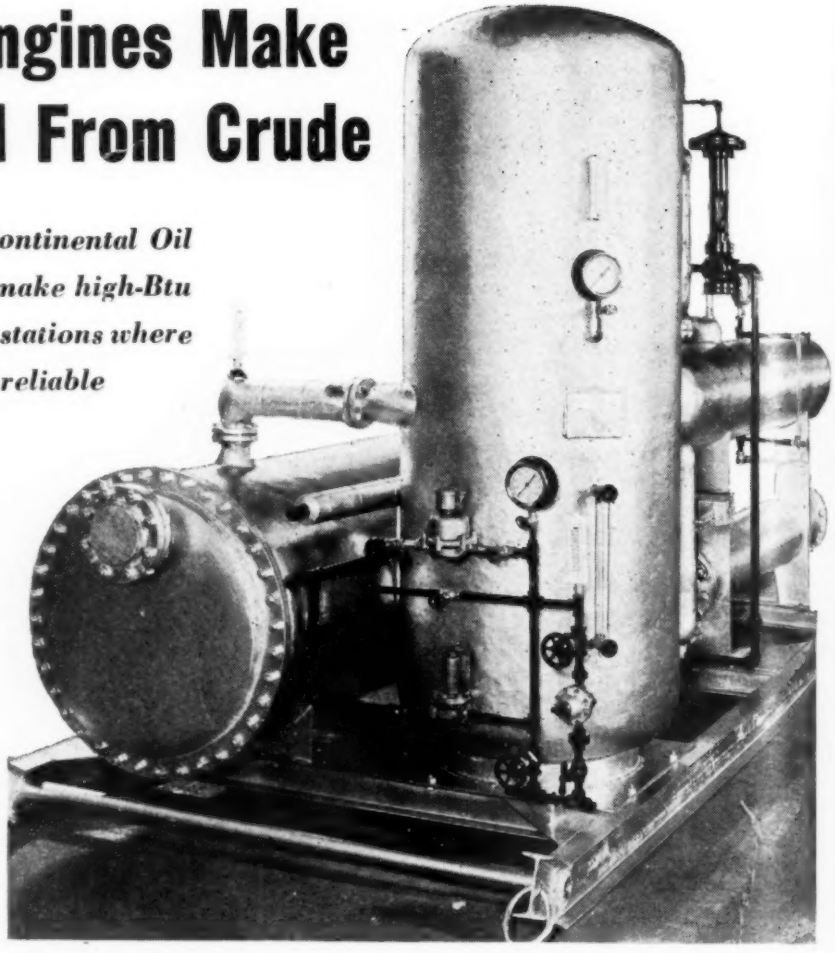
We can learn much from aircraft's effective use of materials, although our design methods and requirements are so radically different that we cannot fully adopt their practices. Our equipment, for instance, is generally so expensive that it has to work right, or nearly right, on the first design attempt. Aircraft designers, with smaller parts, expect to make 10 or 15 attempts before arriving at an optimum combination which, at the end of an allotted life of 1000 to 2000 hr will just fall apart like the famous "one-horse shay."

Suppose a sample of 18 pieces of plywood are to be bonded together to make a 2-inch thick mass, using high frequency electrical heating, employing frequencies in the order of 15 to 20

(*Continued on page* 184)

Pipeline Gas Engines Make Their Own Fuel From Crude

Vaporizing unit designed by Continental Oil engineers uses exhaust heat to make high-Btu fuel for gas engines at pipeline stations where bottled-gas delivery proves unreliable



Flash tower, heat exchangers, valves and controls ready for piping connections

▶ IN LARGE DIESEL-ENGINE pipeline pumping stations, crude oil as fuel represents more or less standard practice. But on small lines, a somewhat different situation exists. The relatively small and high-speed engines suited to such operations usually require a lighter fuel, which must be brought in from outside. If fuel must be supplied anyway, it often proves economical to install gas engines which run lower in first cost. Gas may be piped in from a nearby field or, where natural gas is not available, bottled gas may be delivered by truck.

Truck deliveries may prove difficult and unreliable in winter when snow and mud make side roads impassable. This was true at several pipeline stations of the Continental Oil Co. As an alternative to installing storage capacity to overcome interruptions of supply, J G Dyer, vice-president, in charge of production, and A C Wilkinson, general superintendent of pipe-lines, turned to the possibilities of making gas fuel from the crude flowing in the lines. Experiment and study led to development of a self-contained vaporizing unit which utilizes engine exhaust heat to flash oil into gas. Photos on this and the facing page show the vaporizer as finally built and the diagram below outlines the various steps in the process.

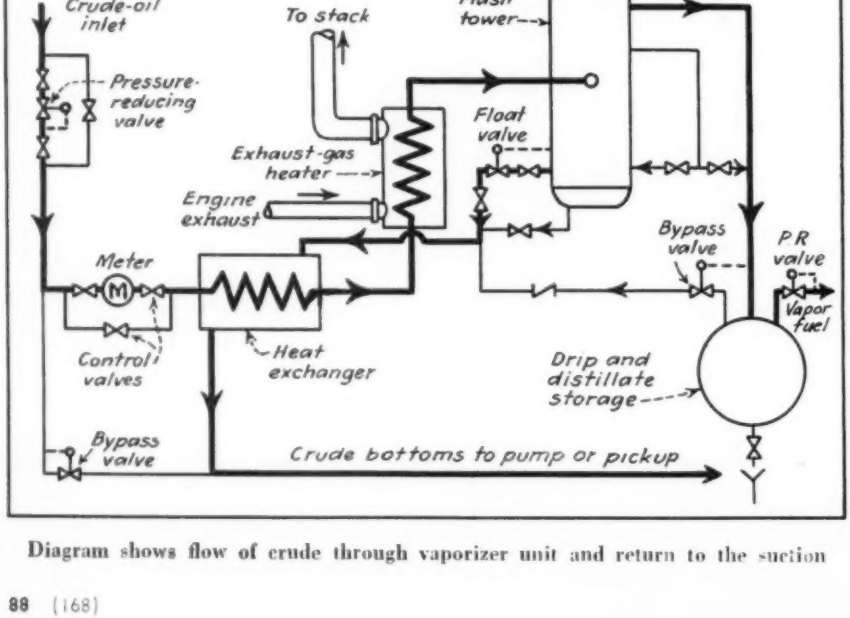


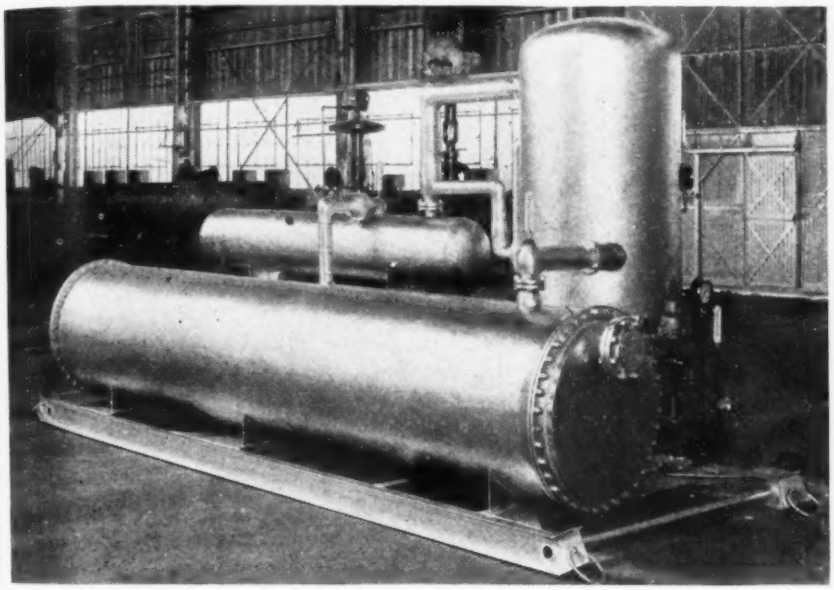
Diagram shows flow of crude through vaporizer unit and return to the suction

Crude from the discharge side of the pumps flows through the unit, and the *bottoms* remaining after gas flashes off return to the suction side of the line. Thus, no additional pumping equipment is required. Only a small part of the line flow goes through the unit; the exact amount depends on engine fuel consumption and characteristics of the crude. High-gravity crudes contain more of the *light ends* that form the gas, and thus required flow is less for such crudes than for those of low gravity.

How Vaporizer Works

Incoming crude passes through a pressure-reducing-valve hookup, with the usual stop valves and bypass, and then through a positive-displacement meter, with control valves and bypass. Preheating takes place in a heat exchanger through which pass the heated bottoms from the flash tower. Crude then flows through an exhaust-gas

heater which raises its temperature to about 300 F at the flash tower. In the tower, light ends separate from the heavier components, passing off to a tank at about 275 F and thence to engine fuel lines or storage. Bottoms from the flash tower, at about 175 to 200 F, flow back through the heat exchanger, giving up heat to the incoming crude, and thence to the suction side of the system.



Mounted on a skid frame, the vaporizer forms a completely self-contained unit

Tower operation resembles somewhat that of a *skimming* or *topping* refinery unit and, as in such units, some light liquid fuel of gasoline type is produced. This is stored and serves as starting fuel for the engines. Operation on this fuel for about one hour after a cold start makes the unit self-supporting.

with adequate exhaust heat available for distilling.

The diagram shows normal operation where suction pressure is less than 125 psi and input can be pressure controlled. Where pumping conditions create internal pressure above what the unit can stand, bottoms flow from the tower to a sump to be pumped back into the suction.

Gas fuel produced by the vaporizing unit runs high in Btu value, a typical sample analyzing as follows:

Propane	3.88%
Butane	5.88%
Pentane	13.75%
Hexane	22.76%
Heptane and heavier	53.70%

This sample showed a heating value of approximately 4900 Btu per cu ft.

It is somewhat difficult to assess the cost of fuel produced in this fashion. Gravity of the crude pumped through the line is somewhat reduced by returning the bottoms; this reduction, tests show, is of the order of 1/100 of 1%. Thus, the heating value per lb of the crude has been lowered a negligible amount. The vaporizing unit costs virtually nothing to operate since, under normal conditions, pumping cost is hardly measurable and heat for distillation comes from exhaust gas that would otherwise be wasted. Thus, major charge against the fuel is fixed cost representing the investment in the vaporizing unit itself.

As finally developed, the vaporizer mounts on an I-beam skid frame and forms a completely self-contained unit including heat exchangers, flash tower, valves and controls. It can be moved readily from one location to another, requiring only connections to oil and exhaust lines. Construction permits outdoor installation if no space is available inside a station.

Continental Oil Co. has several of these units in operation, using stabilized crude pumped through 8 in. lines. One is at Guernsey, Wyo., another at a point near Douglas, Wyo., and a third at Fenton, La. When construction materials become more readily available, equipment of this type will undoubtedly find even wider use in pipeline pumping stations, particularly where fuel delivery is difficult or uneconomical. Consideration is also being given to building smaller units, which may be applied to gas-fuel production for engines pumping crude from wells where gas pressure is no longer sufficient to flow the crude. The device has been patented by its designers.

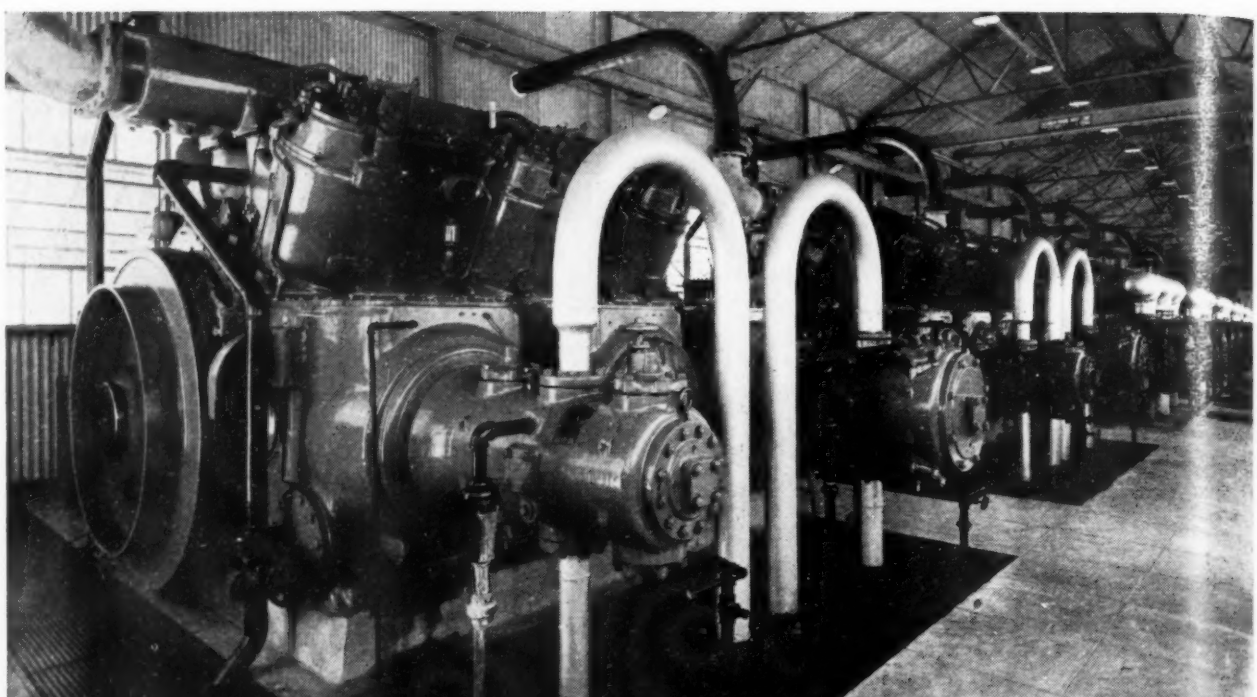
Engine Exhaust Carbonizes Coal

▶ THE HELIOPORE COAL-CARBONIZATION POWER-PLANT PROCESS, recently tested by the U. S. Bureau of Mines in a pilot plant at Golden, Colo., uses exhaust gas from an internal-combustion engine to carbonize noncaking coals in a vertical continuous-type retort. Gas produced by carbonization fuels the engine; engine output is converted into electrical energy in a direct-driven generator.

Under the test conditions, heat in the exhaust gas proved insufficient to carbonize enough coal to operate the engine at full load. Additional high-temperature gas, obtained by burning natural gas, provided 39% of the heat needed. The test report states that the maximum value that can be assigned to the heat available in the engine exhaust indicates that it is not sufficient to carbonize the coal used in supplying fuel for the gas engine and, furthermore, low temperature of the exhaust (1300 to 1500 F in these tests) militates against efficient use for this purpose.

Dr R R Sayers, director of the bureau, says that heat economies obtained by utilizing the engine exhaust gas will not justify any appreciable investment in special equipment. "Aside from the merits of the process as a means for saving and applying engine exhaust heat, the tests produced data that should be of value in the further development of continuous retorts for coal carbonization," the report states.

A copy of the report may be obtained by writing the Bureau of Mines, Department of the Interior, Washington 25, D. C., for Report of Investigations 3733, *Tests of the Heliopore Coal-Carbonization Power-Plant Process*, by A C Fieldner, J D Davis, V F Parry, L D Schmidt, J L Elder, J B Goodman, W S Landers and E W Goodwin.



Part of El Paso Natural Gas Co compressor station at Jal, New Mexico, containing nine units totaling 6200 hp at 300 rpm

How to Plan Gas-Compressor Stations for Long-Range Efficiency

Consider these practical pointers on foundations, cooling system, lubrication, piping and station-building layout

By BRUNO THIEL
The Cooper-Bessemer Corp

► NEED FOR GAS AND GAS DERIVATIVES in production of synthetics, expanded use of recycling and pressure maintenance to increase life expectancy of oil fields, and the trend toward prohibiting wholesale waste of gas given off by producing oil wells—all point to an even further expansion in gas usage. Thus it seems logical to assume that many additional gas compressor stations will be needed despite the promised conversion of a large number of wartime compressor installations.

Although the modern gas compressor station is the result of practical experience and application of engineering principles over a considerable period of time, even today we find that there are changes that can be made in design that will improve efficiency. What are the factors that lead to long-range efficiency, stability and economy and permit the greatest possible benefits from the initial investment? Let's examine each part of the modern compressor station from this point of view.

Foundations: The base for all compressor foundations should be a mat extending under and beyond all compressor foundations unless they rest on solid rock, in which case foundations should be insulated from the rock by some vibration-damping material such as cork. The mat should extend to within a foot or so of building foundations but never to or under them. This would transmit engine vibration to building walls.

If ground at station site is insecure, drive piles to solid ground, with outside row of piles sloped with tops toward center of mat. Use reinforcing steel to tie the top of these piles into the bottom of the mat. This prevents, as far as is possible, transmission of engine vibration to adjacent structures.

All compressor foundations in any one building should rest on the mat in that building, securely anchored. This represents the best way to break up any horizontal shaking forces; forces of one unit tend to counteract those of another unless all units are synchronized, a rare condition in a compressor station. The lower or tension side of the mat needs ample reinforcing and keys should be cast into the top of the mat at surfaces on which compressor foundations rest. The keys tie mat and compressor foundations into one solid mass.

Engineers debate the merits of a basement in a compressor station, but convenience of a basement seems to outweigh any additional cost involved. Providing basement height and arrang-

ing piping for ample headroom and easy access pay dividends in convenience and lower maintenance costs. The growing practice of building basements with but half their height below ground allows installation of full-sized windows, making basement available for storage of spare parts and supplies, and for repair benches and equipment.

Key the compressor foundations into the mat and reinforce well at all points subject to tensile stress. Surround foundation bolts by pipe or duct at least 2.5 times bolt diameter and extending into foundation at least 15 times bolt diameter. Keeping these ducts free of concrete when the foundation is poured facilitates lowering the engine base over the foundation bolts. On large horizontal units where foundation bolts are very long, the duct runs down to the foundation washer so the bolt can be removed when the engine main frame is skidded onto the foundation.

Building the foundation with a step or shelf about 14 in. below the floor line provides a support for floor beams. A step or shelf may also be put in the building-wall foundation for the same purpose. Judicious spacing of foundations eliminates need for additional floor supports, leaving all basement passageways unobstructed. Putting a strip of insulating material such as pitch-impregnated felt at least one inch thick between floor edge and foundations prevents transmission of horizontal forces from engine foundation to building walls.

When grouting an engine, keep thickness nearly uniform over the entire foundation top and not more than 1½ in. This eliminates excessive and uneven shrinkage, which might throw unit out of line after grout dries. Remove leveling wedges and plates after grout sets.

Cooling System: Operators now begin to appreciate that lack of clean scale-free water wrecked more gas-engine installations than any other one thing. The days when cooling water comes from a creek, pond or open cooling-tower basin should be over for all except the most temporary gas-engine installations. Large temperature differentials between incoming and outgoing water (from 40 to 100 F) in earlier plants caused undue strains in cylinders and heads and seizure of many an uncooled piston. Present practice holds temperature differential to 20 F, or less, with resultant better operation and lower maintenance. Lower differential means larger circulating pumps but in the long run decreased maintenance cost offsets additional pump cost.

A closed cooling-water system represents the ideal. In an open system, with a cooling tower, daily makeup never runs less than 5%. This causes an accumulation of mud or sludge in the tower basin great enough to require draining the system and cleaning the basin every few months if scale formation in jackets and heads is to be held to a minimum. Then, too, water in an open system absorbs oxygen in the form of air; the oxygen-loaded water proves highly corrosive when heated. Water-cooled piston rods feel the effects particularly as oxygen attacks steel with greater avidity than cast iron. In a closed system, kept reasonably free of leaks, negligible makeup reduces jacket scaling and corrosion problems to a minimum.

In the most reliable closed system, the pump draws water from an overflow tank or standpipe and forces the water through the heat exchanger and the engine and back to the overflow. The tank or standpipe should have its cover vented to atmosphere and be so constructed that water surface exposed to air is a minimum. The overflow line from the engine should enter the standpipe a short distance below normal water level to prevent any splashing, which increases amount of air dissolved in the water, but should be high enough to provide for a continuous slope upward from engine to standpipe. This releases any entrained air or gas in the cooling-water stream; for this reason all piping should slope upward from the pump to the standpipe. If conditions require deviation from a continually rising line at any point, install an automatic air vent or small bleeder line at the high point in this line.

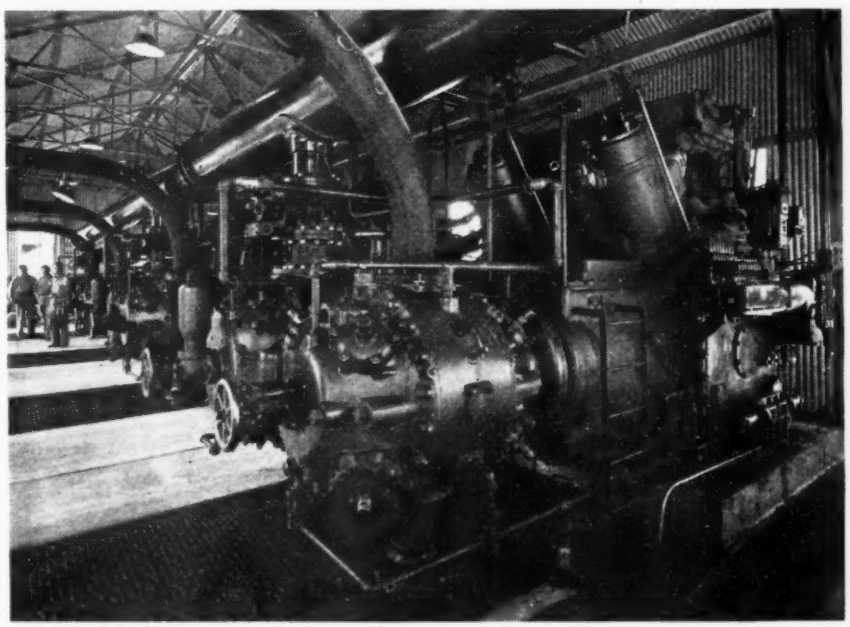
The system should be filled with treated water analyzing about as follows:

Dissolved oxygen—preferably zero but not over 0.05 cc per liter
pH value—not less than 8
Oil, suspended solids—none
Hardness—calcium and magnesium sulphates added, not over 15 ppm: calcium and magnesium carbonates added, not over 75 ppm
Organic matter—not over 5 ppm
Chlorides—not over 6 ppm in terms of chlorine

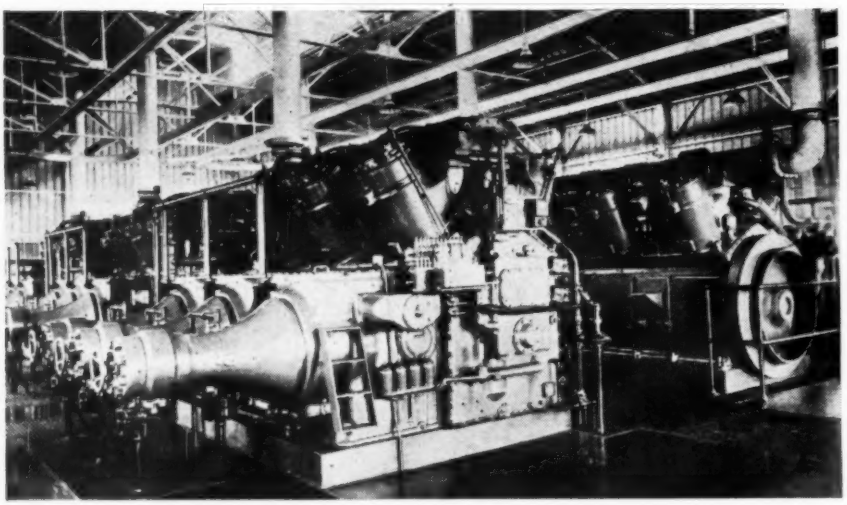
Makeup water should show approximately the same analysis. Zeolite and lime-soda processes may be used to remove scale-forming compounds; potassium or sodium dichromate prevents oxygen corrosion and chlorine or copper sulphate attacks algae growths.

An automatic bypass around the heat exchanger maintains the desired nearly constant differential between inlet and outlet temperatures. If water temperature leaving the engine falls below predetermined point, the bypass allows enough water to flow around the cooler to restore desired temperature. This regulation method requires a heat exchanger large enough to take care of the entire engine output at peak loads with a constant raw-water supply.

Another method regulates flow of raw water to the heat exchanger by means of a valve controlled by engine-outlet-water temperature. This varies the amount of



Four Cooper-Bessemer G-MV 4-cylinder engine-driven compressors rated at 400-hp and 300-rpm each, in Shell Oil Co's East Cromwell Plant, at Wewoka, Oklahoma



J S Abercrombie and Harrison Oil Co pressure-maintenance plant in Old Ocean Field, Texas, has 16 engine-driven units. Shown are six 6-cyl 600-hp 300-rpm machines

heat taken from the jacket water before it enters the engine, holding outlet temperature essentially constant. This method requires a raw-water pump of sufficient capacity to take care of cooling at peak load, and is generally used where raw water is used for other purposes and supply is abundant. For best results supply oil coolers from a separate system.

Calculate water piping for velocities of 4 fps or less and if this means excessive pressure drop in long lines, increase pipe size. An installation with 1000 bhp in main units requires approximately 525 gpm for a 20-F differential, 700 gpm for a 15-F differential and 1050 gpm for a 10-F rise. These figures include cooling water for auxiliary engines and other equipment needing cooling and are based on the heat dissipation of a 2-cycle engine, with oil-cooled pistons and water-cooled exhaust manifolds.

Air Filters: In most cases, the atmosphere around a gas-compressing station carries enough abrasive grit to warrant installation of air filters. The importance of such equipment was demonstrated by inspection of a station in the Dust Bowl. An automatic viscous filter protected one unit; the remaining three operated unprotected. After eleven years' operation, maximum wear in any cylinder of the filter-protected engine was 0.033 in. with an average over all eight cylinder ends of 0.025 in., making average yearly wear for the unit a little more than 0.002 in.

Other units operating under the same conditions but without filter protection showed an average wear of 0.018 in. per cylinder end per year, or an average total wear of 0.198 in. per cylinder end. In effect, filter protection extended by about nine times the period before reboring was required.

Air-filtering equipment should be large enough to avoid excessive pressure drop between outside atmosphere and engine cylinder. This must be watched closely on 2-cycle units because a slight pressure drop in air going to the scavenging cylinder produces a greater effect on maximum power that the engine can develop than it will in a 4-cycle unit. In either 4- or 2-cycle engines, restriction of air supply tends to enrich the mixture in the cylinder and cause the engine to run hot. This may cause piston overheating and seizure.

Exhaust: The 2-cycle engine is, in general, more critical in regard to exhaust pipe length than the 4-cycle type. Experimental data, available to the purchaser, shows the most favorable length of exhaust line for a particular unit. If a muffler is to be installed, it will affect the length of exhaust line between it and the engine and between it and the atmosphere.

Oil Cooler: Compressors equipped with oil-cooled power pistons require an oil cooler. It should be chosen so that pressure drop is at a minimum with maximum heat-exchange capacity and constructed to permit removing tube bundle easily for cleaning. No matter how clean filters may keep oil, some sludge always settles out in the cooler. Divorcing the water circuit for the oil cooler from that for the main unit permits operating compressor at temperature higher than correct for the oil system. As most oil-cooled pistons use lube oil as coolant, filters must handle full flow.

Piping: In the past, most engineers calculated pipe sizes on the basis of amount of gas delivered by a station. This assumes that gas flows in a continuous stream from the compressor. What actually happens is that the compressor takes in gas during a portion of the stroke only and discharges gas during a portion of the next stroke. The amount of gas taken into the compressor cylinder and delivered by it during one revolution depends on the volumetric efficiency of the compressor cylinder. However, the *rate* at which gas is taken in or discharged depends on the velocity of the piston during the time the gas is flowing to or from the compressor cylinder. For example, a double-acting cylinder having a displacement of 100 cfm and a volumetric efficiency of 85% takes in air during 74.44% of one revolution, which means an average rate of 114.3 cfm. Thus a suction pipe calculated on a basis of 85 cfm (100×0.85) proves only 75% large enough. Likewise, the discharge pipe must be calculated on a basis of the *actual* rate of discharge rather than on the rated figure.

If pipes leading to and from compressor cylinders prove too small, the pressure drop cuts compressor capacity and increases power needed to compress a unit gas volume. This is often the reason why compressor stations that are correctly designed as far as compressor horsepower and capacity are concerned do not deliver rated capacity when put into operation.

Intercoolers and aftercoolers should be calculated for pressure drop using the method mentioned above; a restriction here can cause as great a loss in power and capacity as too small a pipe size. In stations having more than one compressor, design headers connecting units on the *actual* rather than the *average* basis and make them large enough to take care of flow when units are synchronized. Failure to do so cuts station capacity and increases horsepower per unit volume. Losses have reached 33% of productive horsepower where piping was known to be undersized.

Safety Devices: Newer compressors can be equipped with a number of safety devices and controls. Overspeed stops and safety stops actuated by low lube-oil pressure, high cooling-water temperature and subnormal cooling-water flow are well known; to them we can add devices to be attached to the bearings that will shut down the unit if bearing temperature becomes excessive or if play in moving parts becomes too great.

Compressor output may be regulated

(*Continued on page* 202)

ABC of Boiler Stresses

A favorite examination question asks the engineer to prove that stress in the longitudinal seam of a cylindrical drum is twice that in the girth seam. Harry Spring gives the how's and why's of the proof

▶A PROBLEM SOMETIMES ASKED in written engineering examinations always appeals to those who enjoy showing how internal pressure in a boiler affects the stresses set up in the shell. The question is: "Show diagrammatically and mathematically that the hoop stresses due to internal pressure in a cylindrical drum are exactly twice the end stresses." Can you prove it?

First let's be sure we know what "hoop" stress and "end" stress mean. Fig. 1 shows a cylindrical shell constructed in two halves, with a band or hoop to hold them together. Steam pressure on the inside of the drum tends to force the two halves apart against the resistance of the band. This puts an internal pull on the band; we say it is in tension. How much pull it can stand depends on the strength of the material in the band and how much material is used.

The amount of material involved is the cross-sectional area of the band and there are two of these areas, one on each side of the drum. It can be seen that for a seamless drum, the shell wall itself is the hoop that holds the steam pressure, and the area of material involved is twice the cross-sectional area, or twice the length times the thickness.

To put this into simple mathematical terms, let's call the thickness of the shell in inches, t, the length in inches, L; and the tensile strength of the material in lb per sq in., TS. Then for a seamless drum, the resisting strength will be:

$$2 \times t \times L \times TS$$

If the steam pressure is high enough to set up a pulling-apart force higher than this resisting strength, the shell will fail. If the pulling-apart force and the resisting strength are equal, nothing happens, and if the pulling-apart force is less than the resisting strength, there is a margin or factor of safety.

To know whether the shell is safe or not, we need to know what pulling-apart force is set up by a given steam pressure. This steam pressure acts equally in every direction, as shown in the lower half of Fig. 2. In checking the pulling-apart force along any line or seam, we are only interested in pressure working at right angles to the line.

To visualize this clearly, look at the upper half of Fig. 2. Here we convert the pressure, acting radially at points on the shell, into two parts, one set of forces acting sideways and one set acting upward, and we have shown them acting on a series of plane surfaces or "steps." While not entirely sound mathematically, this visualization helps understanding and gets to exactly the same place as the full analysis.

At any one time, we are only interested in the forces acting in one direction; let's say vertically, in this case. Now it can be seen that the total area of all the "steps" on which vertical forces act is equal to the diameter of the shell times whatever length of shell we are considering. This is the "projected area" of the shell and is equal to $L \times D$, where D is diameter in inches.

Working on the total area of the steps, or on the projected area, is a certain steam pressure in lb per sq in. If we multiply the area, in sq in., by the pressure, in lb per sq in., we get the total pulling-apart force, in lb. We have already seen that this must equal the resisting strength of the shell. Putting it "mathematically," we have:

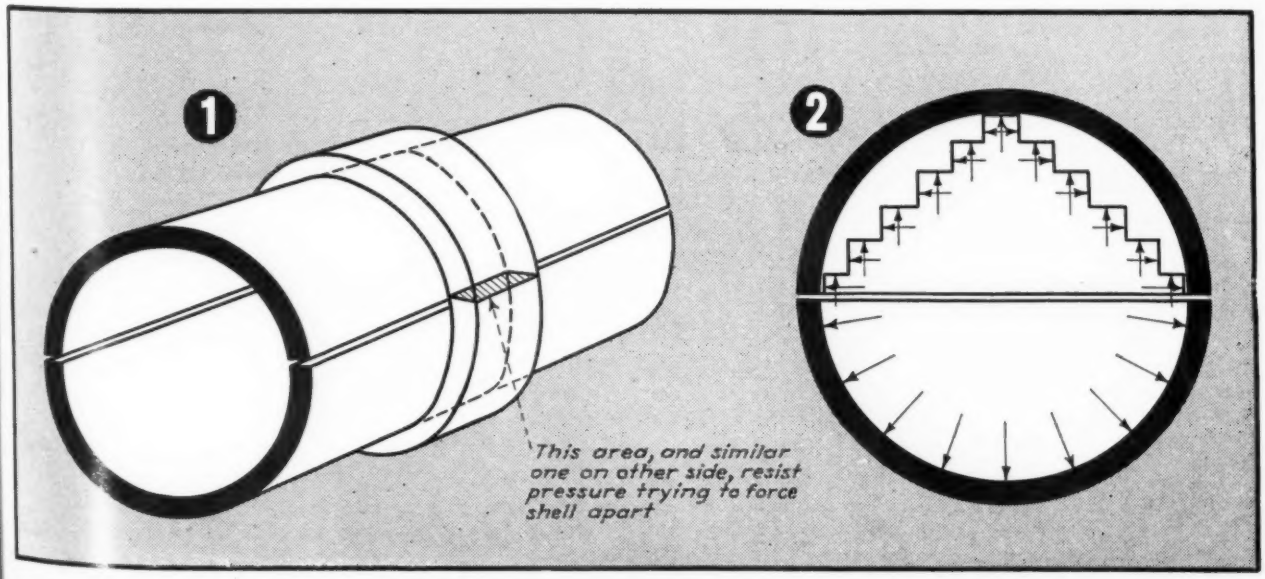
$$L \times D \times P = 2 \times t \times L \times TS$$

where P is steam pressure in lb per sq in.

Since what we want to know is the maximum safe pressure that can be carried in the drum, we re-arrange the figures to get P by itself:

$$P = \frac{2 \times t \times L \times TS}{L \times D}$$

(*Continued on page* 144)



THE OLD CHIEF

HOMEWORK

"By George, he would prosecute next time," thundered the Old Chief

Intent on being a hit at the next big date, 'teen agers used to go out of this world with fancy hat pins, fancy pokers and fancy bread toasters—all made with a carefree use of company time and material. Another in the series by William Doran, chief engineer, Essex Co Sanatorium, Windsor, Ont.

IN OLD-TIME MACHINE-SHOP PARLANCE homework was the term used to imply that someone was putting in a little sly work on something that he intended to take home. Sometimes it was referred to as a "country job," or a "brain child." Perhaps the very improper practice has died away in the apprentices of today, but in my day there were times when every boy in the shop had something, under the bench, that he would work at every time the coast was clear. One of the boys would start things off by making himself a handy little surface gage. Then each of the other boys would endeavor to go one better, bigger or more elaborate, often aided by the advice and help of the older men.

There were three other teen-age boys around the shop at one time and we were under the Assistant Chief who, to tell the truth, left us very little time for homework. But his movments were well known to us and innocent-looking sentries would warn us of the troop movements of the enemy.

A fellow apprentice, called Habbie Wilson, was an expert at making ladies' hat pins, and some of them were as big as the hats the girls are wearing today. He would take a disk of heavy copper about the size of a silver dollar; then he would drill and file it until only the fair one's monogram was left in the circle. An ordinary hat pin was introduced into the center and the whole job polished and shellacked, or electroplated, as funds would permit. I confess to having made four of them myself, each with a different monogram.

Next came an epidemic of fancy pin making. This was accomplished by threading a variety of aluminum, red fiber, black fiber, copper and poker chips on to a piece of fine wire and capping each end with a dome nut. After the shaping and polishing was completed, an ordinary safety pin was soldered to the back.

To find an end of brass tubing over three inches in diameter was to start building a boiler immediately. Another boy and I made a model steamboat which had the good sense to blow up in the middle of the pond where nothing but my boat was hurt. Next came the making of fancy pokers and parlor fireside sets. To make a poker you took a piece of square stuff and heated six inches of the center and twisted an ornamental design in the center into it. Then you put it in the lathe, threaded one end for a fancy knob and the other end for a built-up handle of fancy colors, and polished until not a mark could be detected.

I remember one of our boys whom we called Barney came to work one morning all excited about a swell girl he had met, a newcomer to town. Barney had it real bad and soon there started an output of fancy pins, hat pins and pokers. Fancy bread toasters, which you could hook on the hinge pin of mother's cook stove and swing around to the fire, made wonderful toast. All of Barney's efforts were works of art.

On the Carpet

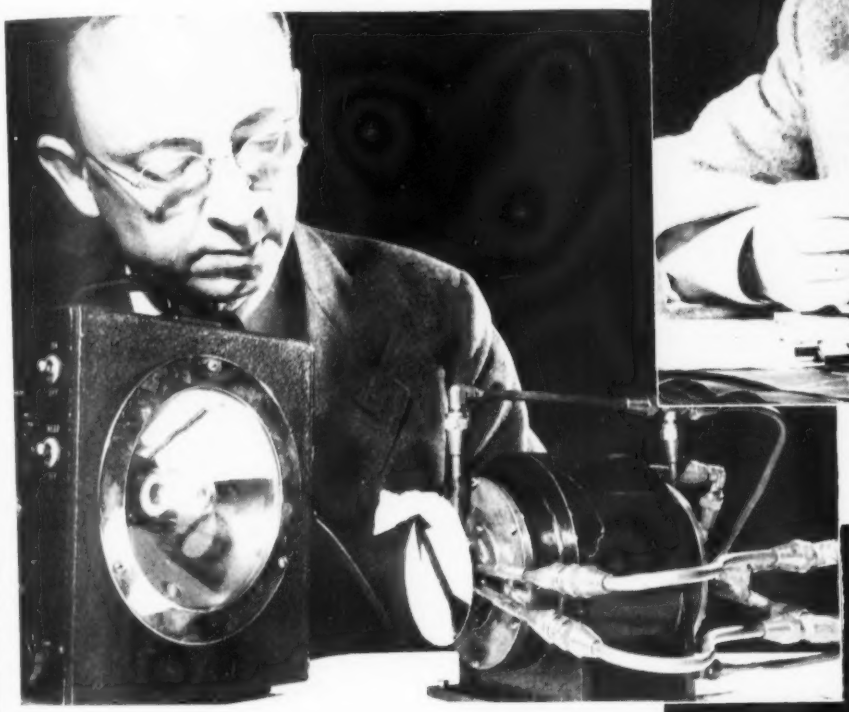
One bright day, however, we were all paraded into the Old Chief's office and on his desk there lay a grand display of Barney's masterpieces. The Old Chief remarked on dishonesty in general and dishonesty in particular. The Assistant Chief was there looking daggers at us. I could see weeks of punching out breachings, cleaning oil filters, swabbing engine pits, digging out smokestack bases and many similar jobs of penance lying before us.

Did we think we were employed to waste our time and steal the company's material? thundered the Old Chief. Did we think he was running a toaster factory? By George, he would prosecute the next time.

We afterwards found out that Barney's blue-eyed wonder was a niece of the Old Chief, and she had shown him what his clever boys were making for all the girls in town. One of the boys still works in the Old Plant. Habbie Wilson lost his nickname but became a topnotch instrument salesman. Barney owns a large tool and die-making concern. And, by the way, he is still unmarried.

TREMENDOUS TRIFLES

In winning a war, little things can be as important as big—here are three examples, small in size, large in accomplishment



Photos are reproduced by courtesy of Westinghouse Electric & Mfg Co

Newest aid for power-line protection, the device Dr. Finzi holds (top) writes with lightning on a plastic slate, giving engineers a record of lightning strokes that hit their lines and showing where protection is needed. Not much bigger than a playing card, the thunderbolt counter consists of two strips of metal foil inclosed between two pieces of transparent plastic. One foil strip has teeth cut in its edge, the points being a few thousandths of an inch from the other strip's straight edge. When lightning strikes, a small current sidetracks into the saw-toothed foil strip. It picks the shortest path, the tooth whose tip is closest to the straightedged strip. As current leaps this gap, it makes a tiny spark which scorches a spot on the plastic and burns away the tooth tip so that the next discharge must seek another path. Counted by a lineman, the spots show the number of lightning strokes

To speed precision-grinding of plane-engine parts and other war equipment, Robert M. Baker designed the world's fastest motor, shown above. Supplied with 1000-cycle current from mg sets, the water-cooled pressure-lubricated motor will drive grinders directly, at 60,000 rpm. This terrific speed is needed to secure a mirror like finish with a small grinding wheel

Designed for a secret gun-control device, the midget mg set (right) takes power from a 110-v 3-phase 240-cycle circuit, operates at a synchronous speed of 14,400 rpm and delivers up to 15 watts of 35-v dc current. Motor and generator rotors are about one inch in diameter and $\frac{7}{8}$ inch long

Purchases of Riley-Jones Stokers

Today, you have to take what coal is available and do the best you can with it. This would not prove a particular hardship if you had installed Riley-Jones Side Dump Stokers because you would be able to efficiently and satisfactorily burn these poorer grades of coal and probably carry higher steam loads than you were formerly able to carry with good coal when hand firing.

Burning Poor Grade Coals with Riley-Jones Stokers

"We use a very cheap coal and it does a better job in the stoker than high grade coal hand fired." *Charlton Woolen Co.*

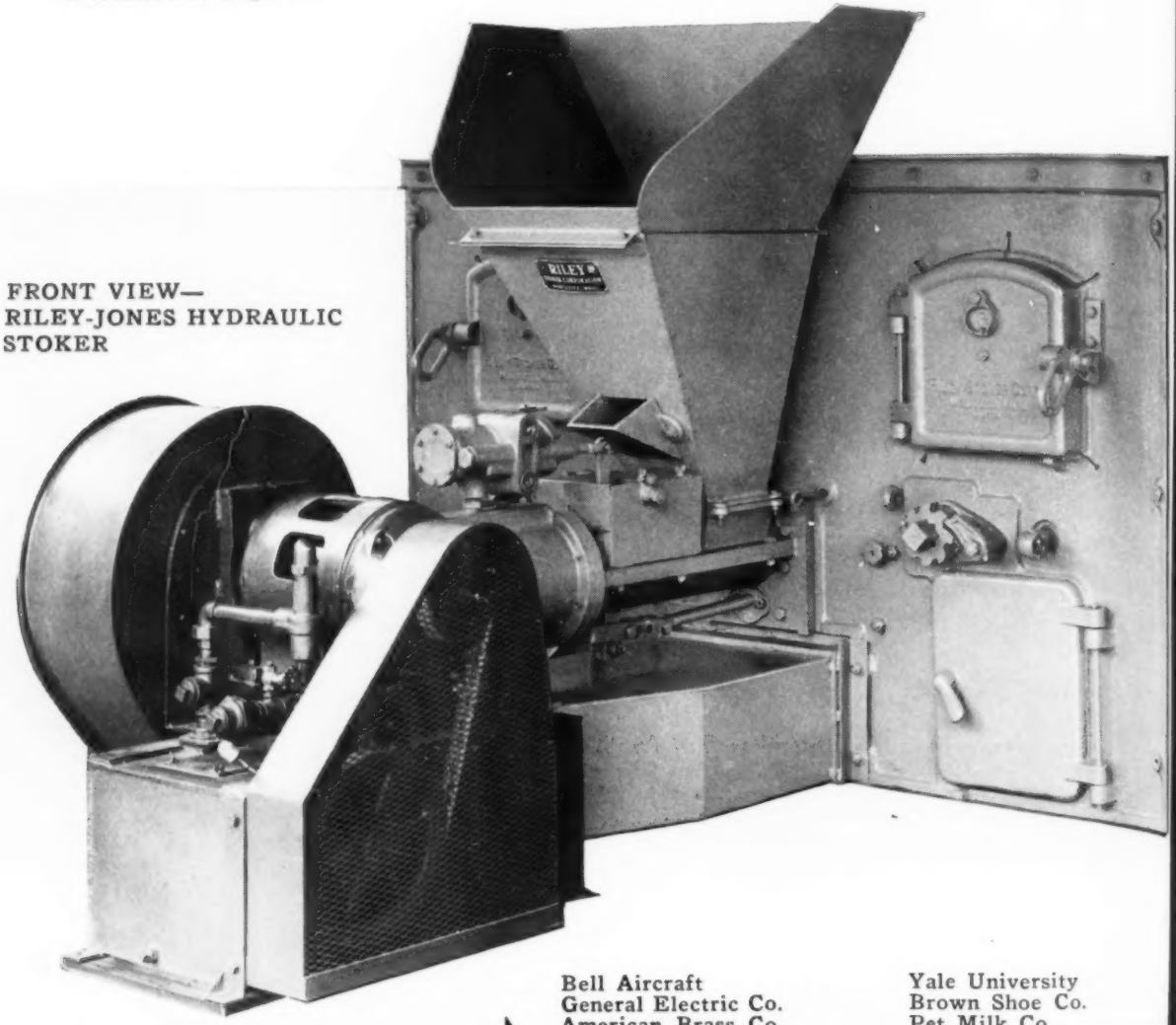
"We can burn a cheap grade of coal and get good results." *Myers Laundry*

"Another feature, it enables you to use a lower grade of coal." *Tomlinson of High Point*

"We have had a considerable benefit from the stokers ability to burn a cheaper coal." *Dehl & Stein*

"We know that we could not use the coal we are now using in hand firing." *Cheyenne Laundry*

"We burn a cheaper grade of coal and do not have smoke." *Crandall, McKenzie & Henderson*



FRONT VIEW—
RILEY-JONES HYDRAULIC
STOKER

These well-known companies use Riley-Jones Side Dump Stokers

Bell Aircraft
General Electric Co.
American Brass Co.
Colt's Patent Fire Arms Co.
Hartford Fire Insurance Co.
Republic Steel Corp.
Minute Tapioca Co.
Yale University
Brown Shoe Co.
Pet Milk Co.
Revere Copper & Brass Co.
Ford Motor Co.
Hercules Powder Co.
Owens-Illinois Glass Co.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Baltimore Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

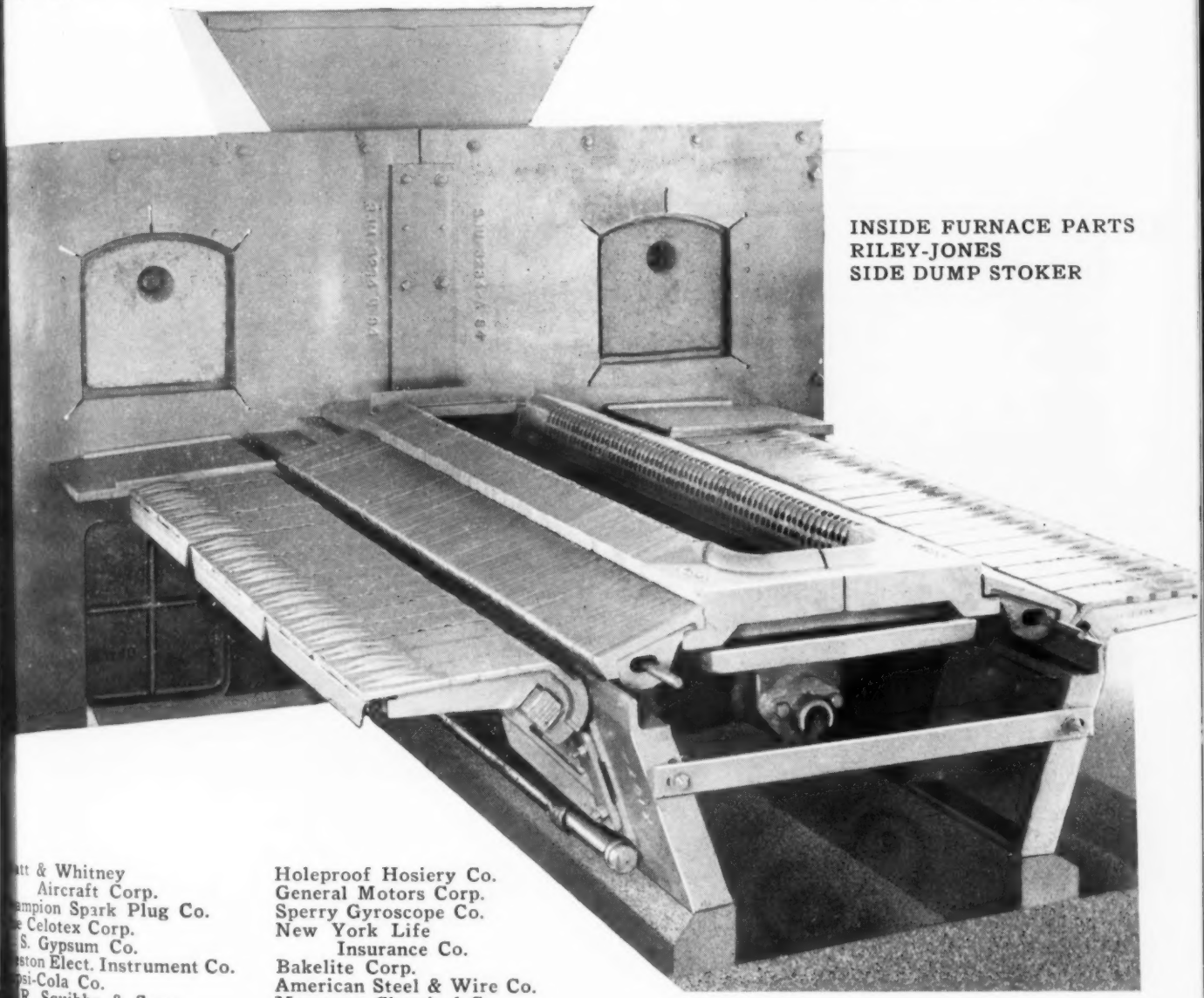
rove even more profitable today

This ability of Riley-Jones Stokers to satisfactorily burn low grade coals makes their purchase even more profitable today. In addition to the ability to maintain high steam output with low grade coal, Riley-Jones Stokers pay for themselves through savings in coal and labor. Coal saving is more important than ever today, due to the existing coal shortage.

Saving Coal with Riley-Jones Stokers

e save at least two to three tons of coal per day over hand fired plant." *Pet Milk Co.*
he saving last year over previous years amounts to 749.00. This saving more than paid for the cost of installation." *Sheriff St. Market*
e have been able to reduce our coal bill approxitely 33⅓%." *Brown Shoe Co.*

"Our Riley-Jones Stoker has surely made us money in many ways." *Crystal Laundry*
"This plant showed a saving of 24.6% over and above the hand fired method." *F. N. Burt Co.*
"The equipment including complete installation can be paid out of fuel savings in between 2 and 3 years." *Anchor Cap and Closure Co.*



INSIDE FURNACE PARTS
RILEY-JONES
SIDE DUMP STOKER

att & Whitney Aircraft Corp.
ampion Spark Plug Co.
e Celotex Corp.
S. Gypsum Co.
ston Elect. Instrument Co.
psi-Cola Co.
R. Squibbs & Sons
rck & Company
Holeproof Hosiery Co.
General Motors Corp.
Sperry Gyroscope Co.
New York Life Insurance Co.
Bakelite Corp.
American Steel & Wire Co.
Monsanto Chemical Co.
R.C.A. Corporation

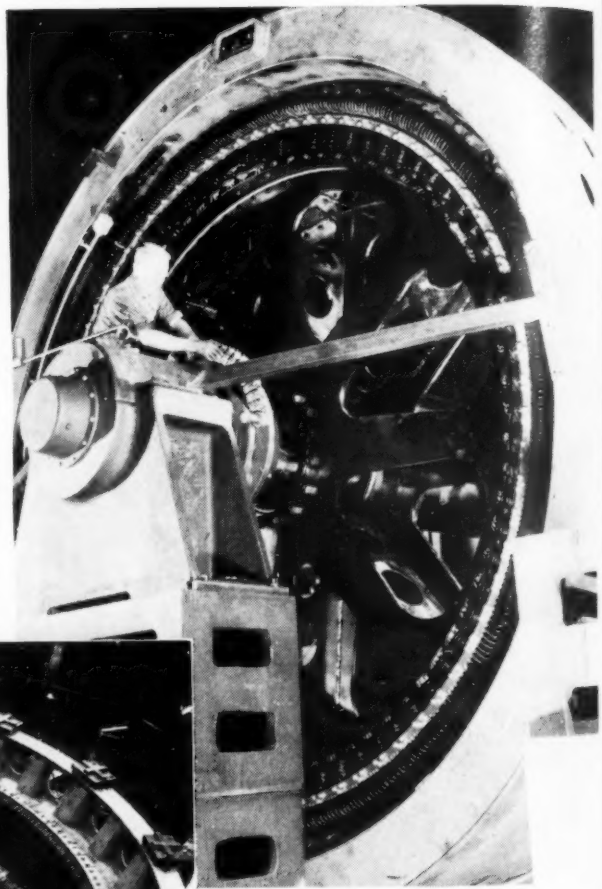
urvey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

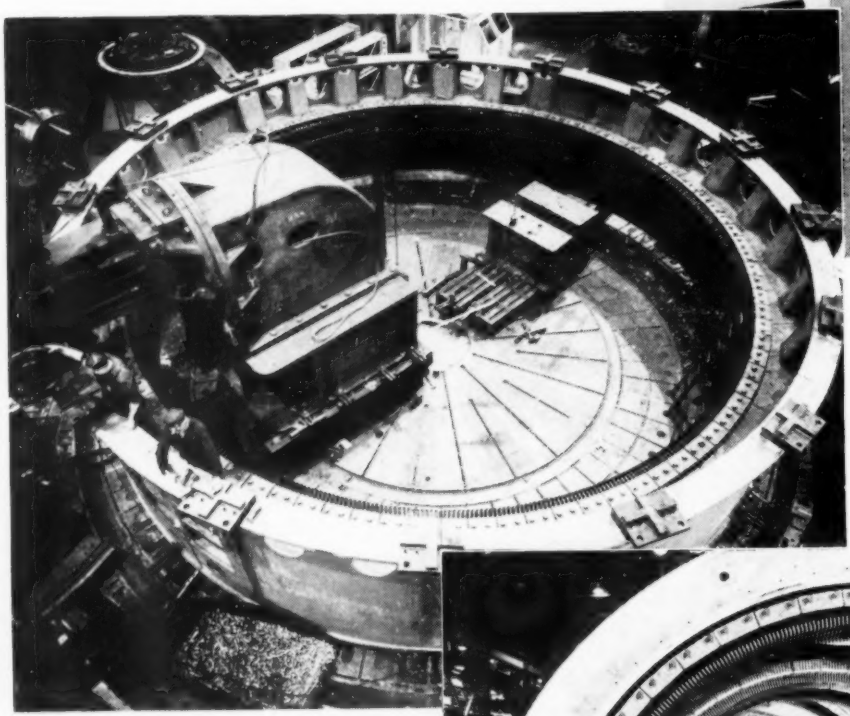
OMPLETE STEAM GENERATING UNITS

ILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
CONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

Giant Power Units for Land and Sea

Whether in the form of huge hydro-electric generators or powerful motors for the merchant marine, electrical equipment fights the battle of kilowatthours on all fronts

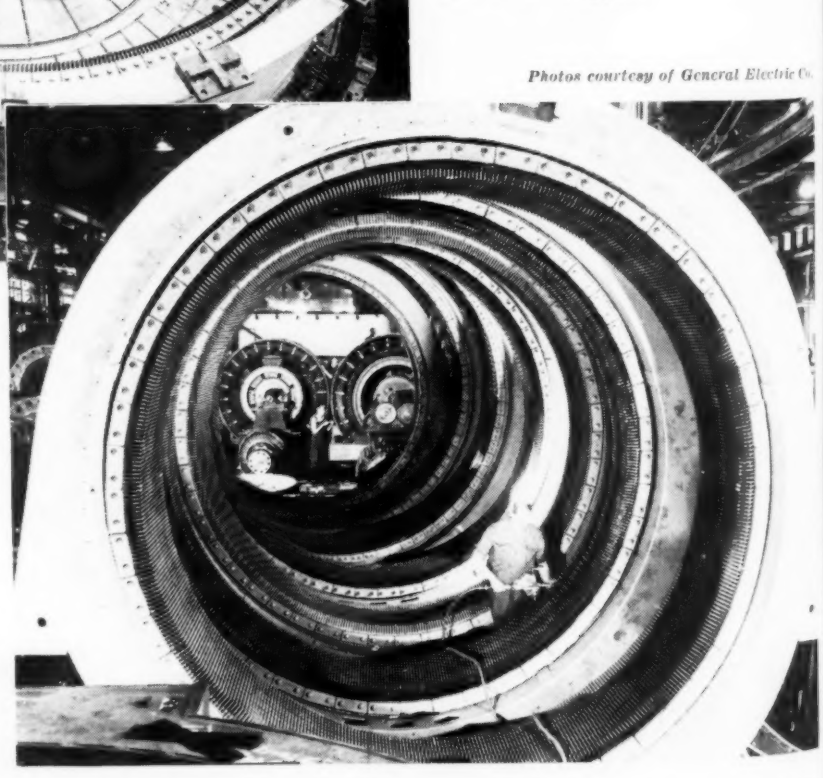




The giant spokes of this 6000-hp motor will soon whirl aboard a cargo ship, speeding supplies to forces overseas. Tommy Burns, veteran mechanic, gives the 16-ft-diameter 112,000-lb unit a final tuneup before it leaves the shop for a West Coast shipyard

Photos courtesy of General Electric Co.

Nearing completion in Schenectady, this waterwheel generator frame is headed for Kentucky Dam, a Tennessee Valley Authority project near Paducah, Ky. The generator, nearly 37 ft. in diameter, is the second of several units ordered for the project



There's a power potential of close to 65,000 hp in this picture. In the foreground are four 16-ft 6000-hp tanker-drive motor frames backed up by three 17-ft 10,000-hp frames for similar use. In the background stand rotors for a 10,000-hp 850,000-lb twin motor which will drive a rolling mill in what will be, when completed, the largest steel mill west of the Mississippi River

Disposal of Government Inventories

How to dispose of government surpluses when the war ends need not be an insuperable problem – if we face it promptly and intelligently. But if we do not, peacetime markets may be disrupted, government funds wasted, production discouraged, and reconversion of the whole economy to peace seriously hampered.

What we need most in order to attack the problem is estimates of how much surplus there will be, in what types of goods, and where.

At the war's end, government inventory of war goods is likely to total around 60 billion dollars. Most of this will consist of aircraft, ships, and other ordnance. Only some 15 billion dollars or less will be in food, clothing, trucks, tools, chemicals, medical supplies, transportation, engineering and communication equipment, and other goods for which there is a civilian market.

In addition, war contractors will have about 10 billion dollars of inventories, the bulk in specialized raw materials, goods in process, and finished products. Only about one-fifth of the total, or some 2 billion dollars, will be marketable or usable for civilian purposes. While the government takes over the usable inventory, the ex-war-contractors will have to build up their stocks for peacetime production, so that on balance, they will not be disposing of usable inventories in large volume.

Not even all of the usable war-end inventory will be "surplus" for sale to civilians in competition with new production. Some of it will be needed by the sizable peacetime Army and Navy we are likely to maintain, and such additional items as can be stored without serious deterioration or obsolescence will be held against possible future war emergencies. Some of it will be disposed of abroad. And up to half of it will be abroad and may be sold there or used for relief.

After allowing for these factors, the war supplies to be disposed of in our own markets probably will be less than 10 billion dollars (cost basis). While the total is not overwhelming – the equivalent of two months' retail sales – in certain lines the surplus will be several years', instead of a few months', normal supply. In particular, the volume of scrap metals available from otherwise unusable munitions will present a problem.

A great deal can be done now to reduce the size of the postwar surpluses by achieving a better balance between military needs and supplies and avoiding excessive inventories of particular raw materials or finished goods. This work needs to be pressed, not only to simplify our transition to peace but also to prevent wasting productive energies during the war. Furthermore, when the war ends on one front, inventories of war materiel should be worked down to the reduced scale of remaining military activity.

We cannot develop programs of action until we know approximately how much of each type of item is to be sold, and where and when it will be available. Wide margins of error are inevitable as long as large-scale procurement and large-scale consumption are still taking place; yet such information is essential and must be developed. Indeed, improved inventory records and estimates are badly needed for the conduct of the war as well as for managing the surpluses after hostilities cease.

In decisions on the disposal of war-goods inventories, the public interest must be the prime consideration. Proposals that none of these goods should be sold domestically because of competition with new production obviously are untenable. Everything that is not needed by the Armed Services or for other special purposes should be disposed of ultimately. The real problem is not whether surpluses should be sold, but rather to whom, at what price, and at what time the sale should be effected.

In the distribution of such large quantities of goods, we believe that established trade channels should be used wherever possible. Otherwise, we shall witness widespread speculation in war goods and the mushroom growth of inefficient and disruptive fly-by-night distributors. This will benefit only a few speculators and will discourage legitimate producers and distributors from making their normal commitments.

All war contractors should have the privilege of retaining those inventories for which they are willing to pay actual cost or a fair price negotiated with the gov-

ernment procurement agency. The balance of the inventories in the hands of war producers should be assembled by the government and sold in an organized manner. It is of great importance that the plants be cleared of these inventories at once so that the process of conversion to peacetime operation can proceed without further delay. To accomplish this, preparations must be made before the end of the war for speedy determination of the inventories to be moved and for a huge volume of storage space to accommodate them.

The price which can be realized and the timing of sale are closely related. Certainly the best prices will not be secured if the government attempts to dispose of large supplies of material and products suddenly without regard to market conditions. Most businessmen rightly favor an early transfer of surplus inventories from government to private ownership. But, they also realize that if all the surpluses are dumped indiscriminately as they become available, many markets will be badly depressed, and the resulting low prices will bring lower production. If this depression effect becomes general, as it easily can, it will be costly to the nation in terms of jobs, income, and goods.

In industries in which production is inadequate to meet postwar demands, an immediate sale of government inventories can prevent inflated prices and preserve balanced market conditions. In cases in which the surpluses are large in relation to annual production, the disposition can be scheduled over a period of years. Generally, however, it will be best to clear the surpluses as quickly as orderly sale can be accomplished rather than to leave them as a continuing threat overhanging the market. Most industries can, and should, take the disposal process in their stride without special dispensations from the government. In this connection, it should be noted that the tax provisions for carry-back of losses and excess profit credits after the war greatly increase the possibilities for speedy disposal of surpluses without serious injury to producers.

There will be some industries, however, in which the postwar surplus is so large that it would practically saturate the market for years to come. The problem of these industries is further complicated by their wartime expansion of capacity many fold in excess of peacetime requirements. These lines of production are, moreover, crucial for our national defense. Aircraft and shipbuilding are cases in point. Each of these situations calls for careful study and discussion by all concerned to devise means to keep alive the necessary production organizations, the research effort, and the spirit of enterprise. Insofar as possible, the individual manufacturers should work out their own salvation in the conversion to peacetime markets. They can do this by taking on new lines, by increasing their production efficiency, and by developing technical improvements which make the existing inventories obsolete. But they still will need some kind of government protection or assistance while the huge surpluses are being worked off. It is most important, however, that such protection or subsidy be limited to a period of three to five years. It must not become permanent unless it is really essential for our national security.

The disposal of surplus inventories is part of the whole process of demobilization of the war effort and conversion to peace. If this process is to be accomplished with minimum dislocation and injury to our economy, it will have to be directed by a central agency which has developed adequate information service and is in position to coordinate the policies of the Armed Services and the other interested executive branches of the government. This agency should draw freely on the knowledge of businessmen in the specialized problems of marketing surpluses in each industry. It should formulate definite programs of inventory disposal for all industries in which the problem is acute; and it should make these programs public as soon as possible, so that business can plan for the future with confidence. In large measure, the success with which we make the economic transition to peace will depend on the quality of government administration in the process of industrial demobilization. We shall need better organization for the transition to peace than we had in mobilization for war if we are to avoid needless unemployment, loss of production, and frustration of business enterprise.

President, McGraw-Hill Publishing Company, Inc.

'Dizzy Diagrammatics' Save Time

These new-system sketches, with their distorted ellipses, look strange at first, but they are easy to understand and save a lot of time and money in the drafting room and plant

By H E PILKINGTON
Design div, engineering dept
E I duPont de Nemours & Co
Wilmington, Del.

▶"DIZZY DIAGRAMMATICS" is a simplified method of plant layout design which I, and those under my supervision, have been using quite successfully for the past few years. It is a diagrammatic arrangement showing clearly and specifying completely each piece of equipment.

Considerable opposition and criticism of this type of drawing arose before it was accepted. Before its development the usual design procedure had been a standard mechanical arrangement, drawing, locating and specifying each piece of equipment. The diagrammatics, being much easier to make and entirely satisfactory, won out.

The mechanical-arrangement drawing, originally used, actually consisted of three separate tracings, each 30x42 in., including one sheet of plans, one of elevations, and one of sections. Approximately 60 man-hours of work was required for each. In addition, these drawings were traced over, the equipment shown in light lines and the piping, valves, controls, etc, drawn in and specified. These tracings each required another 50 man-hours.

Convenient for Field Use

In the field, the construction superintendent uses the new diagrammatic as a construction manual. From it he can readily point out to his foremen and mechanics the various runs of pipe, fittings, valves and controls. It gives the mechanic who cannot read blueprints a complete photographic picture of the plant as a whole, enabling him to work more intelligently at his own particular job.

Finally, the operating manager, handicapped as he often is today by inexperienced operators, can use this diagrammatic as a flowsheet, coloring each pipe line, valve and control shown on the blueprint with a distinctive color, and adding a color key.

The print, thus colored, can be pasted on the wall of the operating room where an inexperienced operator can readily trace the different pipe lines and locate the control valves, thus saving many an expensive shutdown.

Diagrammatics resemble isometric drawings, but do not involve such laborious projection. They are much easier to read and far easier to make.

Fig. 1 shows the basic arrangement of the three primary directions in a standard drawing and in the corresponding diagrammatic. The lower left-hand

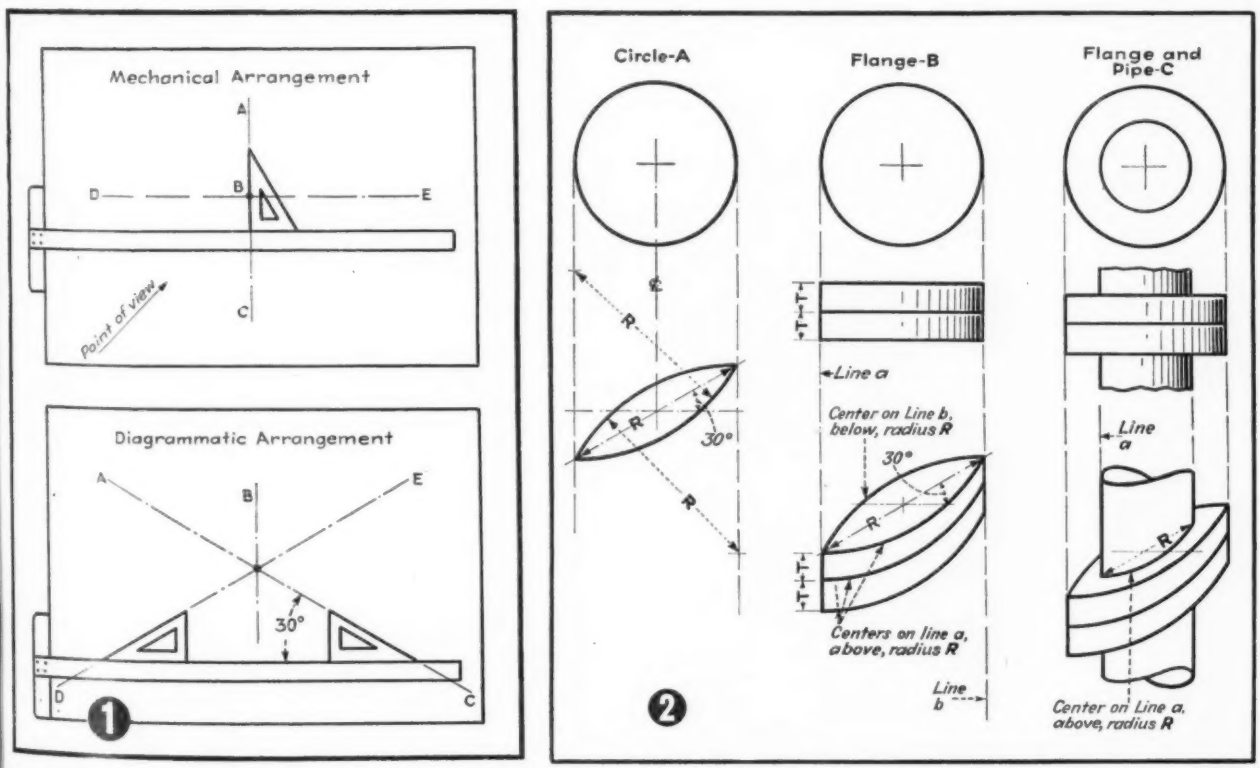
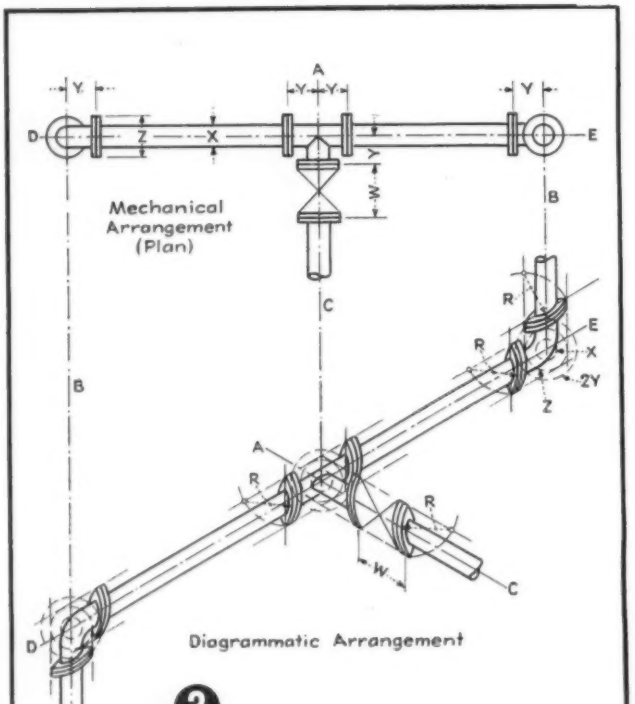
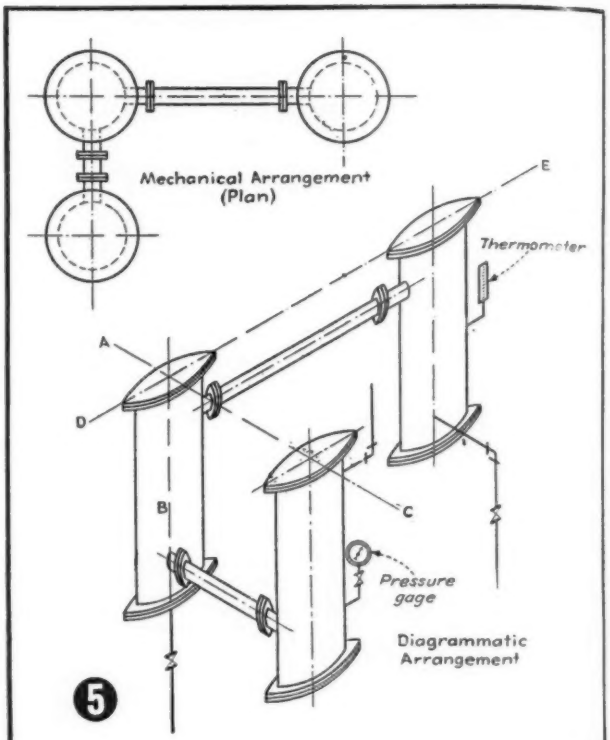


Fig. 1—In the standard mechanical plan (above) and in the diagrammatic plan (below), consider *B* a vertical line, *AC* a north-south line, say, and *DE* an east-west line. Fig. 2—Flange ends, pipe ends, fitting ends and tank ends are circles. In sketch *A*, see how two arcs, drawn as shown, can represent a circle in "perspective." Note the 30-deg tilt of axis. Length of this axis is used as radius *R* of the arcs. In sketches *B* and *C*, exactly same method portrays flange and pipe circles





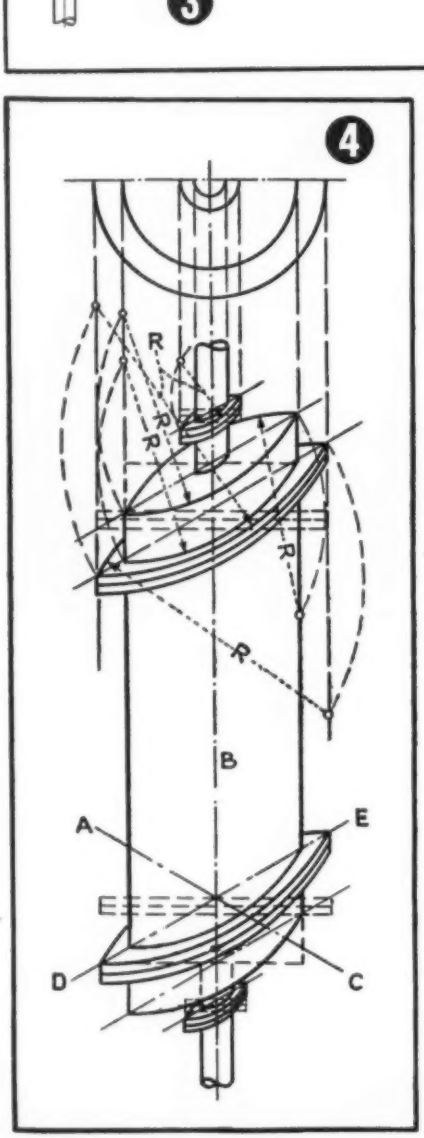


Fig. 3—The diagrammatic method is applied to drawing a simple pipe layout. Fig. 4—Here cylindrical tank is diagrammed on tracing paper or on cloth laid over an elevation view. Despite apparent confusion of the construction lines and arcs, each is drawn exactly as shown in Fig. 2. Fig. 5—Here the tanks are drawn as shown in Fig. 4, but the pipes are lengthened arbitrarily to spread the equipment

point of view, as indicated, is generally most satisfactory and is used in the following descriptions.

Point *B* in the upper sketch represents any vertical riser or vertical center line. This appears as a line in the diagrammatic. Line *AC* is any line running up and down on the mechanical drawing and *DE* any line running left and right. Corresponding lines on the diagram carry the same letters and slope 30 deg from the horizontal. Thus, in the lower sketch *B* represents a vertical line, *AC* represents an up-and-down line on the mechanical drawing, *DE* a left-right line.

Fig. 2 shows how to portray a circle (pipe, flange or tank end) by two arcs. In Fig. 3 the circle 2Y is drawn with a radius equal to the dimension *Y*, the center-to-face of fittings. At times this circle may have to be increased to avoid interference of flanges. Circle *Z* is drawn equal to the diameter of the flange of the fitting or apparatus. Diameter of circle *X* is that of the pipe or apparatus.

Parallel lines are drawn tangent to these circles as shown by the dashed lines, and are used as construction lines for the diagrammatic, later to be erased from the finished tracing. Construction is the same as shown in Fig. 2.

A mechanical arrangement drawn to a scale of ½ in. to the foot is the most satisfactory size from which to reproduce the diagrammatic. Cut dummies of the equipment from prints of the elevations or sections and paste on a piece of drawing paper in positions corresponding to their respective locations on the mechanical arrangement.

Locate these dummies so that each piece of equipment will show clearly. This may require increasing the center to center distance of the equipment, as in Fig. 5.

Projection of Dummies

Fig. 4 shows how to transfer the dummies from the mechanical to the projected view of the diagrammatic. The light dashed lines would not be used in an actual drawing, but here represent the dummy visible through the tracing. The projected diagrammatic itself is shown in heavy lines.

Don't attempt to project such items as gages and thermometers. They can be shown as in Fig. 5. This also shows how pipe, valves and fittings under 2 in. can be drawn as single lines.

Charts Guide Safe Loading of Power Transformers

Two charts, one for modern and another for older designs, give copper- and oil-temperature rises in power transformers for any load cycle and operating time, and show whether they are operating within safe temperature limits

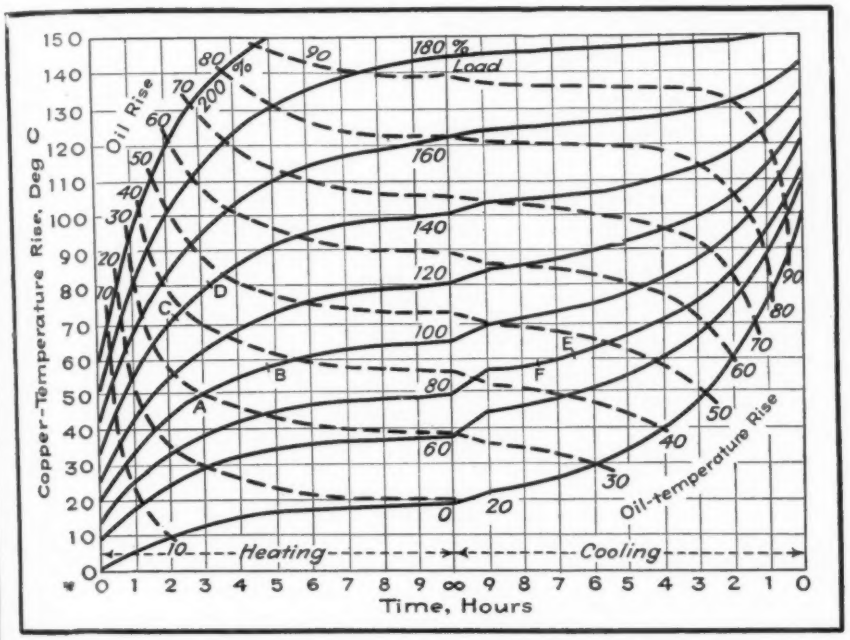


Fig. 1—Copper and oil-heating and cooling curves for typical modern power transformer, having full-load hot-spot gradient of 20 C, oil temperature rise 45 C, ratio of copper loss to iron loss of two, and thermal-time constant of three hours

Table 1—Load Time Duration, Copper Hot-Spot Rise and Final Copper Temperature at 10 C Ambient From the Chart, Fig. 1

Load, %	*Time, hours*			*Final copper hot-spot rise, deg C*	*Final copper temp at 10 C amb*
	Elapsed	*Starting*	*Final*		
100	2	2.8	4.8	58	68
140	1	2.2	3.2	82	92
80	1	6.6	7.6	58	68

Table II—Final Copper Temperatures From Table I, Compared With Safe Temperature Limits

Final time, hours	*Final copper rise, deg C*	*Final copper temp at 10 C amb*	*Temp limit, deg C*
4.8	58	68	105
3.2	82	92	105
7.6	58	8	105

▶ MANY CONDITIONS under which power transformers are overloaded are covered in the American Standards Association's *Guides for Overloading Transformers* and the interim reports on overloading, but they do not take care of every situation encountered. To help fill this gap, W C Sealey and J B Hodtum, Allis-Chalmers Mfg Co, at the American Institute of Electrical Engineers' winter convention, presented charts from which to determine the safety of transformers on practically any load cycle.

Transformer Heating

A transformer connected to power lines has heat generated in its copper winding and iron core. Starting cold, a portion of this heat is absorbed by the copper because of its thermal capacity and a portion goes into the oil. After the oil temperature increases, it dissipates heat to the cooling medium, usually the atmosphere surrounding the transformer.

Rate at which insulation deteriorates on the transformer's windings depends on its temperature; increase in temperature increases insulation deterioration. It is assumed that a transformer will have a satisfactory length of life when operated continuously at a 95-C copper hot-spot temperature. If operating temperature is below 95-C part of the time, the transformer can be operated above 95-C for a period and have the same life as when operated at 95-C continuously. By taking advantage of this fact, higher loads and temperatures can be permitted for short periods of operation. If a transformer is cool when an overload is applied, advantage may be taken of the transformer-material thermal capacity and higher overloads carried more safely than when it is hot.

Fig. 1 shows heating and cooling curves of a typical power transformer of modern design having a 20-C full-load hot-spot gradient and a 45-C oil rise. These curves are drawn for 0, 60, 80, 100, 120, 140, 180 and 200% loads for

a copper hot-spot temperature rise above ambient air. Dotted curves are drawn through points of equal oil temperatures, the values of which are indicated by the figures at the ends of each curve.

These curves not only permit finding copper and oil temperatures for any load cycle but also present a physical picture of temperature rise and fall during a load cycle. On the left-hand side of the chart, the curves show how copper and oil temperatures of transformers increase with time at a given load. On the right-hand side, the curves show how transformer temperature decreases with load and time when the final temperature is lower than the initial.

Application of Charts

To use the chart, Fig. 1, assume a given transformer in service under loads that cause a 30-C oil rise. Starting under this condition, what will the transformer temperature be after it supplies 100% load for 2 hr, then 140% load for 1 hr, followed by an 80% load for 1 hr.? Will it be safe to operate the transformer on this load cycle?

On the 100% load curve, 30-C oil rise corresponds to 2.8 hr, point *A*, which is the beginning of the load cycle. Load continues at 100% for 2 hr, which, added to 2.8 hr, gives an operating time of 4.8 hr, point *B*. At this time copper temperature rises to 58-C and oil to 38-C. To get on the 140% load curve, follow to the left from point *B* parallel to the 40-C oil curve to point *C*. This point corresponds to the oil temperature at the end of the 100% load period and a time of 2.2 hr. Time 2.2 hr, plus 1 hr, equals 3.2 hr. At time 3.2 hr. on the 140% load curve, point *D*, copper-temperature rise is 82-C and oil temperature, 47-C, the condition at the end of 1-hr operation under 140% load.

To find the starting point for the 80% load run, follow from point *D* to the right, parallel to the 50-C oil-rise curve, to point *E* on the 80% load curve. The time here corresponds to 6.6 hr. Under this load, transformer temperature decreases. Then, for 1 hr follow to left along the 80% load curve to time 7.6 hr, point *F*. By this time, copper-temperature rise drops to 58-C, and oil to 44-C.

For convenience in calculating final copper temperature, the load, time and copper-rise values may be arranged as in Table I. Since the copper hot-spot temperature is below 95-C at all times during the load cycle, the transformer can carry the load safely when the ambient temperature does not exceed 10-C.

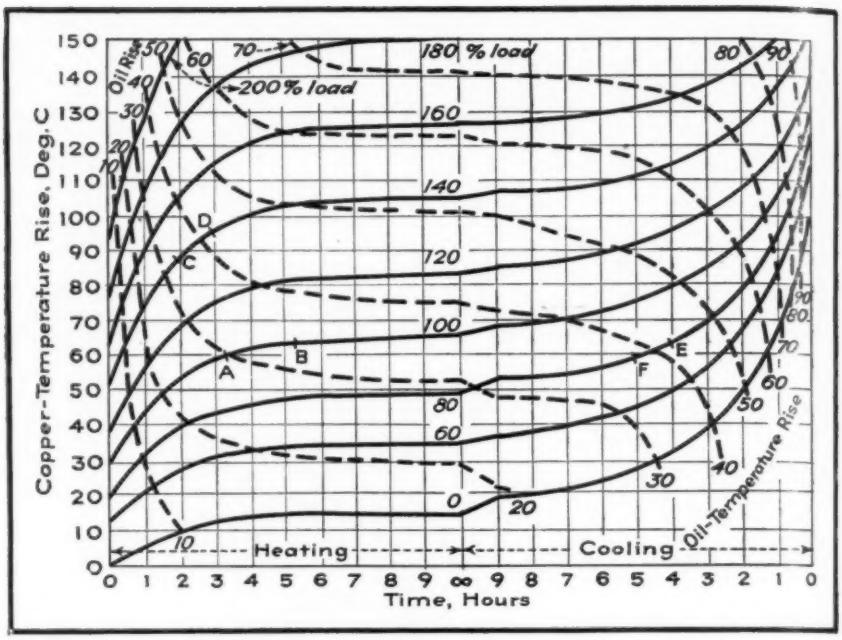


Fig. 2—Copper- and oil-heating and cooling curves for typical older design of power transformer, having full-load hot-spot gradient of 30 C, oil rise of 35 C, ratio of copper loss to iron loss of two, and thermal-time constant of two hours

Table III—Load, Time Duration, Copper Hot-Spot Rise and Final Copper Temperature at 10 C Ambient Obtained From the Chart, Fig. 2

Load, %	*Time, hours*			*Final copper hot-spot rise, deg C*	*Final copper temp at 10 C amb*
	Elapsed	*Starting*	*Final*		
100	2	3.3	5.3	63	73
140	1	1.8	2.8	95	105
80	1	4	5	59	69

Any load cycle can be followed on the chart by the process just described and the oil and copper temperatures at any point on the cycle readily determined. Also at any point in the cycle, effect of increased time may be determined since by inspection it is obvious whether further increase in time will greatly increase or decrease the copper- and oil-temperature rise.

The higher the ambient temperature, the more closely the transformer's temperature approaches unsafe values during the load cycle. An approximate method of arriving at safe load and temperature limits compares the final copper temperature with the ASA standards for short-time loading. The following temperature limits may be used for recurrent loads.

2 hr or less—temperature limit 110 C
8 hr or less—temperature limit 105 C
24 hr or less—temperature limit 95 C

Transformer copper hot-spot temperature, calculated as the sum of copper temperature rise, Fig. 1, and the ambient temperature should not exceed these values.

If copper temperatures obtained during the load cycle do not exceed these values for the times corresponding to those obtained from the curves, Fig. 1, loading is within safe limits. In Table II, final time, copper rise, final temperature at 10 C obtained in the problem are compared with the temperature limit for 8-hr operation. The temperature limit for 4.8, 3.2 and 7.6 hr is 105 C, given in right-hand column. Final copper temperatures are all below the limit of 105 C, consequently the loads may be carried with safety. According to the table, the ambient temperature could have been 105 − 92 = 13 C higher, or 23 C before a safe temperature would be exceeded.

Some of the older transformers may

(*Continued on page* 164)

THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS → ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Old-Timer Resorts to Gland Surgery

An unusual turbine repair brings new lease of life to standby unit badly needed for war loads. Merrill Young tells the story from Steilacoom, Washington

IT COULD HAVE BEEN DONE, as some proposed, by cutting off the entire low-pressure sealing gland, facing and drilling the turbine casing and bolting on new glands. But this would have taken much time and the cost would have been considerable.

Two turbines in an old section of a modern central station had seen only occasional service for several years. Damage to the glands had been growing in extent for a long time and the only quick remedy, at time of turbine inspection, was to fill the affected area with soft metal and peen it smooth. After this treatment, the turbine could be sealed by maintaining about 5-psi gage pressure at the sealing-water inlet.

Trouble Recurs

However, after a short time the soft metal sloughed away and the sealing-water pressure had to be increased gradually up to as high as 75 psi. At high loads the seals occasionally broke with all the attendant operating ills that accompany such misfortune.

The operating staff took little satisfaction in the knowledge that city water, aerated and containing some abrasive, was probably responsible for the corrosion. Condensate was not readily available as these turbines exhaust to jet condensers. And the damage had already been done.

Glands were of the familiar, integrally cast, shielded-impeller, low-pressure, water-seal type. They had eroded as shown in Fig. 1. The method of repair was originated and carried out by an

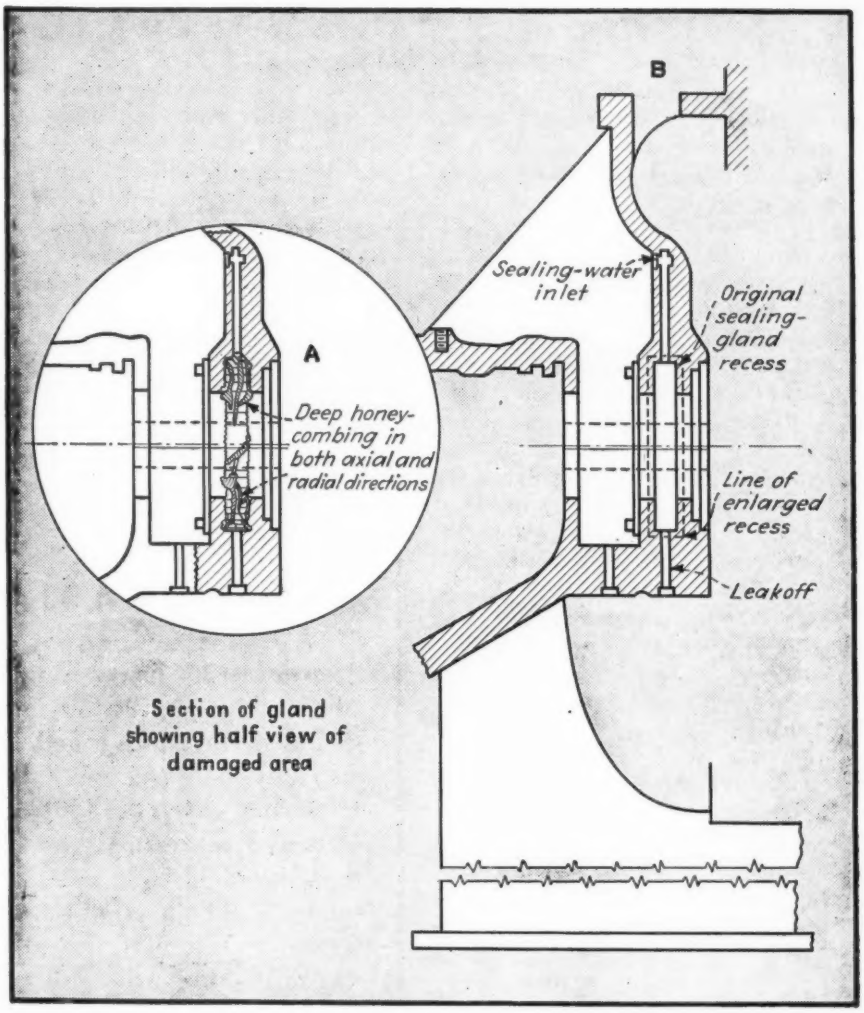
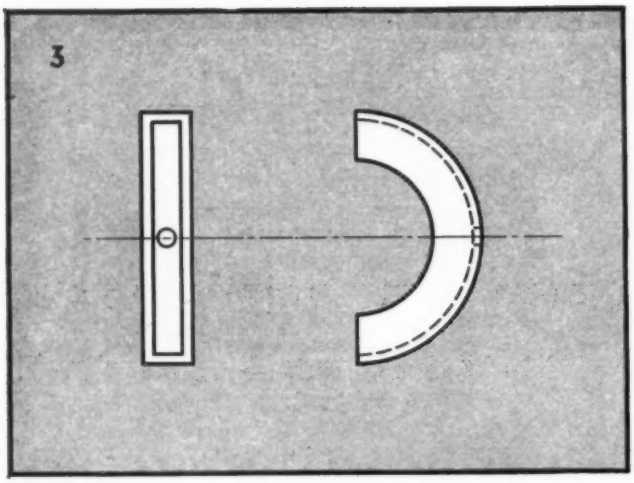


Fig. 1—Low-pressure sealing-gland casing irregularly honeycombed over a period of years, seriously affecting the safety of thin metal in the gland casings. Fig. 2—Gland casing widened and deepened to limit indicated by dotted line to clean out the honeycombed metal. A boring bar did it, cradled in bearing seats



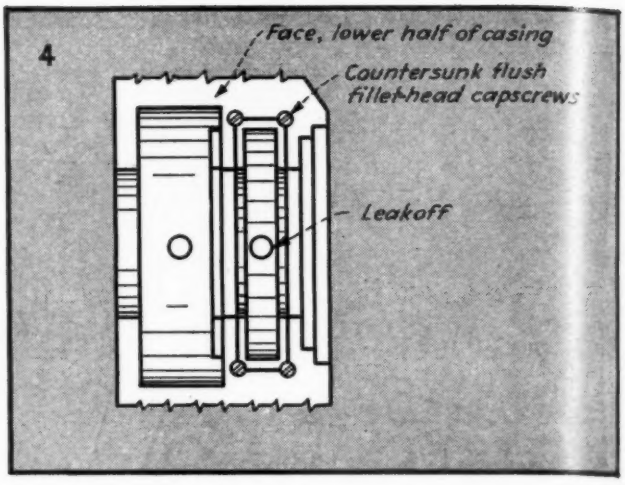


Fig. 3—Cast-alloy liner halves were fabricated to close dimensions and finish ground on all sides to a perfect fit within the widened and deepened gland casings of the turbine. **Fig. 4—Each half liner was locked into place by four countersunk screws set at the intersecting corners. Ends of liner castings were ground flush and polished.**

old-timer, one of those resourceful individuals whose ingenuity has tided more than one plant over a tight situation.

After checking the extent of metal wastage and calculating the thickness of metal remaining, he proposed turning down the damaged casting, as in Fig. 2, and installing new cast gland-liner sections, shown in Fig. 3.

Air Drill Drives Bar

A 4-in. boring bar, equipped with cutter head and feed screw, was mounted in specially designed bearings cradled in the main bearing seats and held rigid by the bearing caps. A 20-to-1 right-angle worm-gear speed reducer was hooked up to an ordinary air drill for drive power. While the latter did not develop much power, the output was enough for the light cuts required.

The driving device was anchored to a channel frame secured partly by the thrust-bearing hold-down bolts and partly by a leg extended to the turbine foundation. Instant speed control was achieved by a throttle valve conveniently located in the air hose supplying the drill.

The actual machining operation was slow, for frequent tool changing and occasional rest periods for the operator, who had to spend many hours in a cramped, prone position to check progress of the cut. However, the total machining time for the gland casings of two turbines added up to only 57 hours.

In selecting material for the new liners, care was taken to assure a material that would not have too great a differential-temperature expansion from that of the seasoned cast iron of the turbine casings. The liner halves were finally cast of a suitable alloy to fairly close dimensions so that only about $\frac{1}{16}$ inch of metal had to be removed for surface finish.

Liners were finished by grinding on all sides. After they were fitted, each half into its recess, the halves were fixed in place by countersunk lock screws set at intersecting corners of the liners where they met the turbine casing flange. Ends of the liners were ground flush with the flanges and polished.

New gland runners were fitted to the turbine spindle and the turbines reassembled, adjusted and tested. In all, the work on the two machines required eleven 8-hr days for four men, and 85 hours for the single machinist, a total of 437 man-hours.

While the gland machining was in progress, a tank was installed on the turbine-room roof to receive condensate from the new section of the plant. In the future, condensate will be distributed to the sealing glands of the old machines by gravity at about 10-psi pressure. Leakoff outlets to the old jet condensers were plugged and the leakoff from the glands piped back to the distilled-water storage of the new section.

Of course, these old machines are not so efficient as they might be, but they will be able to turn out many a kilowatt-hour for war production before new capacity will become available from overburdened equipment manufacturers.

WASTE PAPER AS GOOD AS NEW—ALMOST

Aside from heavy war consumption, the chief cause of the present paper shortage is dearth of wood choppers to bring in the pulp wood. There's still enough paper-mill capacity.

That's why there's a big drive on salvage. Every ton of salvaged magazines, newspapers, paper boxes and paper boards going into the beaters emerges as so much new material. So keep this stuff away from bonfires and incinerators. Get it to the used-paper dealer. He'll get it to the mill. Meanwhile, work with the rest of your community to cut down needless wrapping and other waste of war-scarce paper.

REFRIGERATION NOTEBOOK — 12

Quick-Freezing of Foods At Low Temperatures

By TERRY MITCHELL, M E, *Frick Company*

NOW THAT MORE FOODS are being quick-frozen by the low-temperature air-blast method than any other, engineers are asking how this system operates.

The diagram shows the arrangement of such a freezer. The cold air can be blown either lengthwise or crosswise of the tunnel: 250 ft per min is a typical air speed for crosswise freezing. To aid in removing frost, which is necessary only occasionally, trap doors are provided below the cooling coils.

An anteroom may take the place of the precooling and tempering compartments. The coils can also be placed at the side of the tunnel instead of overhead, in which case the air velocity may be speeded up to 2500 ft per min to form a "blizzard" freezer; the foods are then always handled in batches on push trucks. Metal conveyors may replace the trucks in the tunnel freezer.

Drying Is Negligible

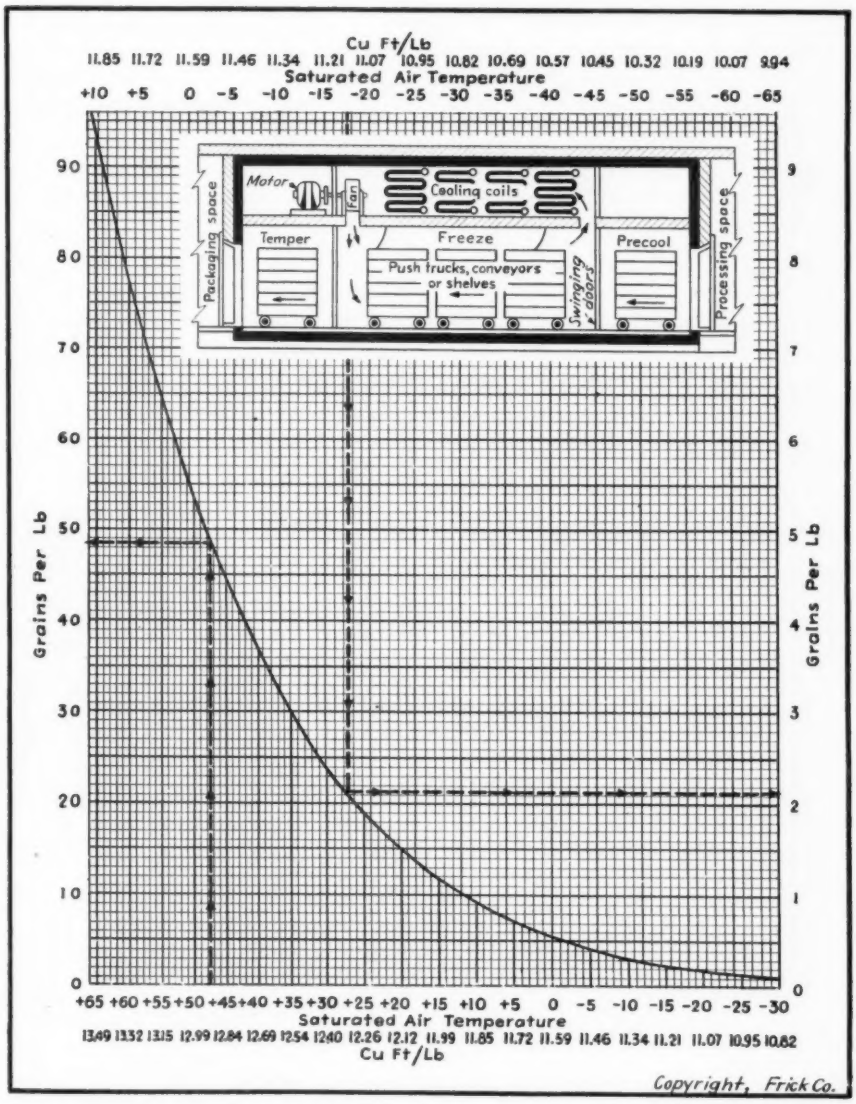
Temperatures from 25 F below zero, down, are commonly held in these freezers, using booster ammonia compressors, with intercoolers, to maintain economy. Float-valve control feeds the liquid ammonia to the coils, which are made with headers large enough to act as surge drums. Some freezers have propeller fans, others squirrel-cage: choice depends largely upon quantity of moisture encountered.

At first, some operators claimed that the air blast would dry out foods. With the use of lower temperatures and small ranges, this is no longer a danger. Really cold air can take up so little moisture when warmed a few degrees in passing over the foods, that the drying effect is negligible. See lower right-hand corner of chart. Quick-frozen in a blast tunnel in Omaha under test, 44,000 lb of turkeys lost only ⅓ of 1% of their original weight. (Each turkey was wrapped loosely in one sheet of 35-lb wax paper, tied with a single loop of string.)

Cold-air freezers are able to handle any foods required. A fruit packer, unable to obtain cans for sliced apples, put them in cellophane-lined cartons, with 20% sugar, and quick-froze them. The same tunnels can be used for freezing fish, shrimp, vegetables, ice cream, etc. When the product is always the same, the arrangement of the freezer may be adapted to include refrigerated shelving, special pans, double-deck conveyors or air baffles.

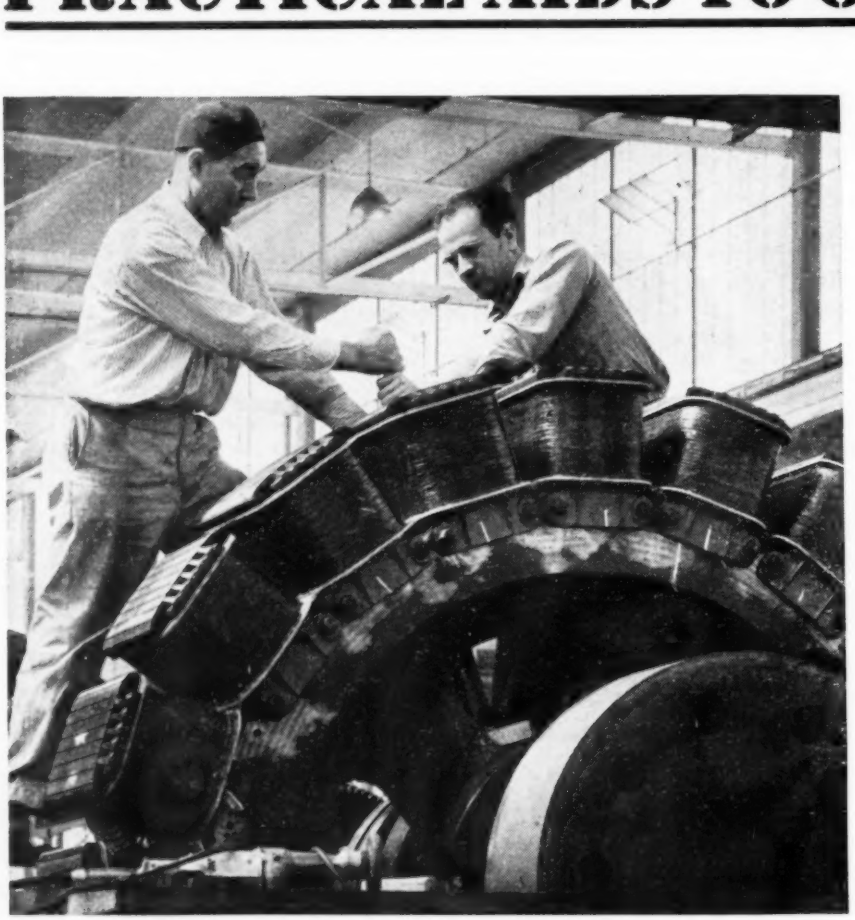
Saturated air's moisture content depends on its temperature if pressure and volume remain the same. Small changes in pressure found in the ordinary circulating systems need not be taken into account when determining weight of moisture in the air.

For low air temperatures, enter chart at the top, select and follow vertical temperature line down to the curve, then look to the right to find moisture weight. Enter the chart at the bottom for higher air temperatures and read moisture content on the vertical scale at the left of the curve.



This curve has two sets of ordinates: Moisture-carrying capacity of air at low temperatures is read at top and right; for higher temperatures, see figures at bottom and left. Diagram (inset above) shows a section through a low-temperature air-blast freezing tunnel —*Chart and diagram, courtesy Frick Company*

PRACTICAL AIDS TO OPERATION



Old Generators Take on New Job

AFTER SUPPLYING DC POWER to Spokane, Wash., street cars for more than 33 years, two large Westinghouse motor generators have been reconditioned to charge submarine batteries at 325 v, at a coast Navy Yard. Originally rated 600 v, 2500 amp, 1500 kw at 360 rpm, it was necessary to rewind these machines for a lower voltage and higher current. Because of shape and size of the armature coil slots and improvements in insulating materials, a higher percentage of copper could be used in the new armature and field windings than in the old.

Rating of the rewound generators is now 4000 amp at 325 v with a corresponding reduction in output. The revamped generator armatures are now connected parallel, instead of in series as originally. Increase from 2500 to 4000 amp required larger brushes on the commutators. Even with these brushes, generator ratings had to be decreased from 1500 to 1300 kw, because the old commutators limited output to 4000 amp.

AC motors driving the generators originally operated on 4000 v, but were rewound for 2300 v, the local power-supply voltage. Other characteristics of the motors remained unchanged, with their 3-phase windings connected delta to provide 2150 hp at 360 rpm.

Hospital Tape Returns Water Heater to Service

WHEN I OPENED our 450-gal hot-water tank I discovered a leak in one of the steam coils between two of the pipes facing toward the shell in an inaccessible spot that could not be seen ordinarily. As it happened I was draining the boiler when the valve was open between the heater coil and the boiler. Sound of air going into the hole in the coil announced its location.

This coil was not only leaking but it was distorted out of round, and could not be peened to a nearly true circle so that a rubber gasket and split clamp might be applied. After several unsuccessful attempts to repair the leak, I applied several layers of hospital adhesive tape around it, and finished the job by applying a home-made copper clamp. I also cut steam pressure on the coils to 5 psi and water pressure to 30 psi.

The tank now works better and takes less steam than for years. However, the copper tubing is weak and distorted in places and the inspector tells me that it may fail at any time. My supply man says that if the coils are replaced I must use galvanized-iron pipe because copper cannot be obtained. It looks as though I might be up against it. If anyone will suggest a solution, I will appreciate it.

Peterborough, N. H. A H PARKER
Engineer, Peterborough Hospital

Emergency Bracing Protects Pipe and Fittings

DURING COLD WEATHER outside piping has to be watched closely to prevent bursting at joints and bends due to

contraction and expansion. Steam and hot-liquid lines, which pass from one plant to another across an exposed area, are frequently injured when cut off and quickly cooled by freezing weather. In such instances, take precautions to protect welds and joints from breakage or excessive stresses.

One plant operator provides inexpensive protection to important welded joints where the angle is 25 deg or more. He welds a section, cut from a length

of heavy pipe, across the angle, as shown in the photo. While this section does not prevent the pipeline from expanding or contracting, it shifts the bending point and distributes the stress along a greater length on either side of the weld. Because of its convex cross-section, reinforcements from pieces of pipe lend greater strength than do straight lengths of cold-rolled steel of equal cross-section. Where a valve or other threaded fitting is within a foot or two of a sharp angle or bend, the brace is extended to include the fitting.

For threaded fittings away from angles in long pipe lengths the mechanic welded together two sections of pipe, like that in the photo, to form an angle of about 135 deg. This V-shaped brace he welded across the valve or fitting to relieve the stress on the threaded connections. This unusual practice would not have been resorted to if new fittings could have been obtained when old ones showed signs of leaking.

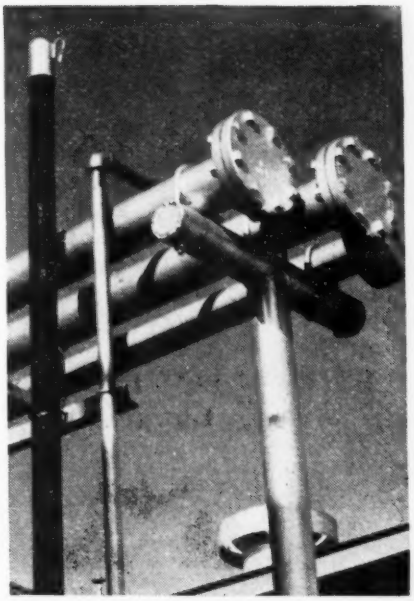
As a result of this emergency bracing, fewer cracked welds and fitting troubles occur in the plant. At the same time, existing piping has not been altered and fewer replacements have been necessary.

Pomona, Calif. G M WILSON

Tin Cans Protect Gas Engines

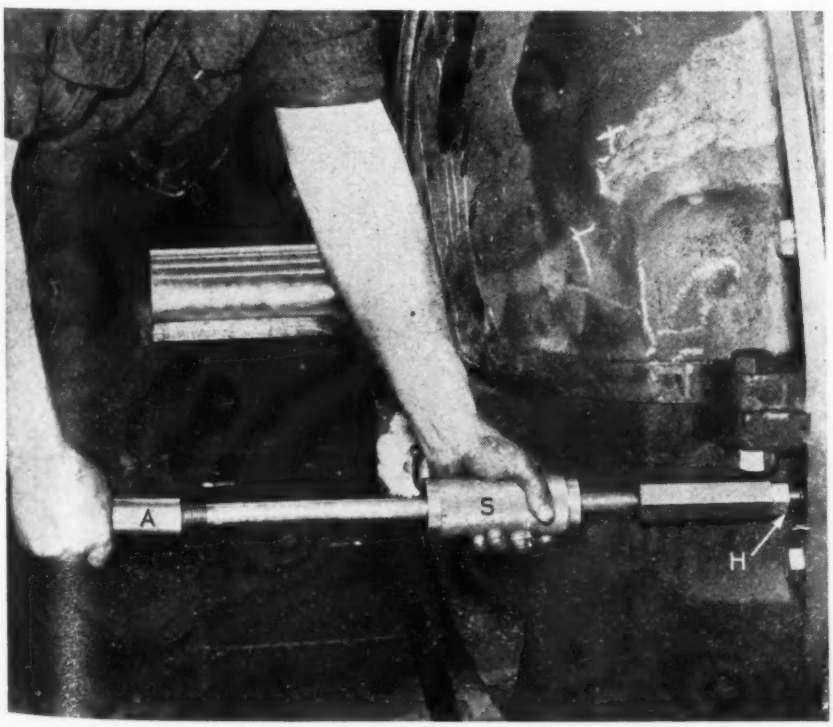
WHERE A NUMBER of small gas engines were used for auxiliary power to drive water pumps and electric generators, the operator had trouble with rain coming down the exhaust pipes which extend above the plant roof. At times, the engines might be idle for long periods and the water would damage valves, ports and manifolds.

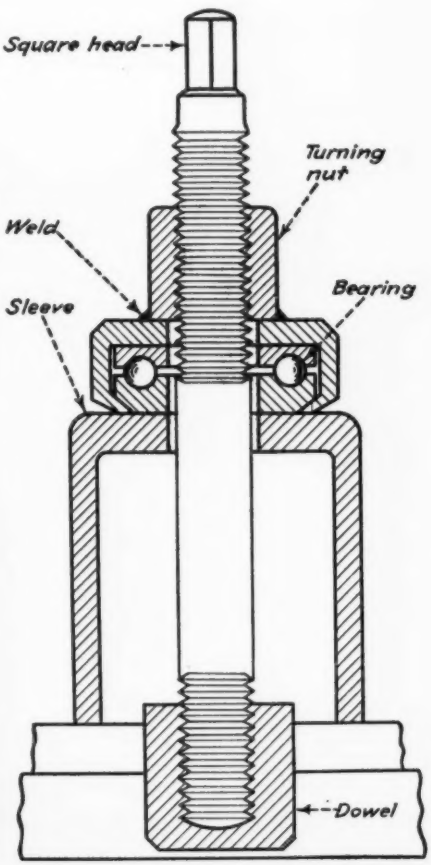
To eliminate the difficulty, the operator made covers for the exposed ends of the exhaust pipes from old fruit cans, large enough to go over the pipe ends, as in photo. To install and remove them easily as well as to hang them on a convenient hook near the engines, the operator soldered a handle to each cover.



Two Designs of Dowel-Pin Pullers

TWO TYPES of dowel-pin pullers suggested by workmen are used effectively at General Electric's Schenectady works. One, suggested by Francis Barton and shown in the photo, has a knurled, cylindrical, sliding member, *S*, which serves as a hammer. It slides along a shaft which is threaded at both ends. One end of the shaft is fitted with interchangeable heads, *H*, threaded to fit various-sized dowel pins. The other end of the shaft is fitted with a turned piece of machine steel, *A*, which serves as an anvil against which sliding member, *S*, is pounded to remove the dowel. This device can also be used to drive





dowel pins into place by reversing the action of the sliding member.

Second dowel-pin puller, shown in the diagram and suggested by Samuel Solini, employs a turning nut into which a ball bearing has been inserted. The bearing eliminates friction between turning nut and the sleeve, making it easy to exert a strong and steady force on the dowel pin, and reducing wear on working parts.

Covers Prevent Splashing From Drain Funnels

IN THE DRAIN LINE from a process tank, trouble developed from the liquid splashing from the funnels into which the lines discharged. These lines had to stay open for observation. The difficulty was eliminated by installing light sheet-metal covers in the tops of the funnels as in the photo. The ends of the drain lines fit snugly in the center of the covers so that air currents in the funnels will not displace them.

Santa Monica, Calif. J C ALBRIGHT

Photo, courtesy Air Reduction Sales Co.

Makeshift Flame Cutter Severs Tubing

WHEN EXTRA-HEAVY-WALLED TUBING requires cutting, and hand-operated machines are unavailable or over-burdened, use an oxyacetylene-flame-cutting method like that in the photo. This method, conceived by F J Valentine, Brooklyn, N. Y., is used on 6-in. seamless tubing weighing 150 lb per ft. The device supports and revolves the tubing beneath a stationary cutting torch mounted on a radiograph. A drill press through worm gear *G* slowly reels in a wire wrapped around the tubing to rotate it. Tube rotation regulated to conform to torch cutting speed, remains constant at one-third revolution per minute as the wire coils around a ½-in. shaft.

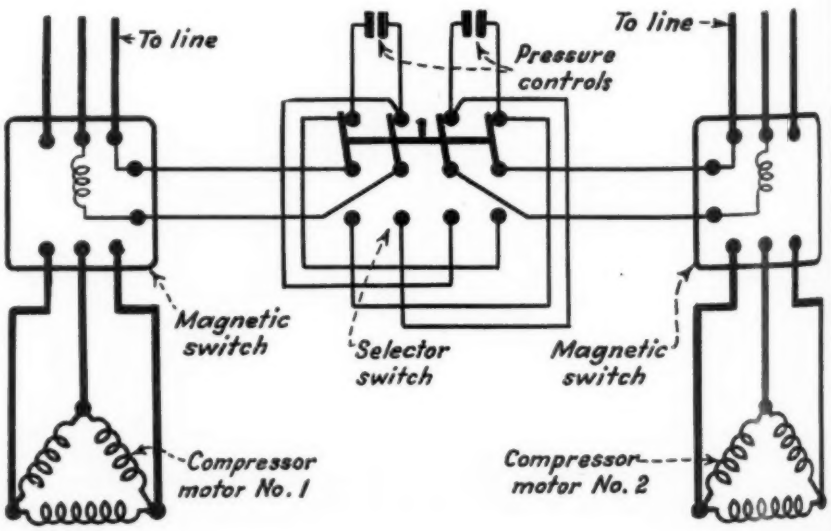
Pitching the tube downward toward the drive end by elevating one of the dollies a few inches, eliminates end movement during cutting. A roller welded to a vertical support at the drive end maintains the tube in this position by butting against the end surface. Cutting is done at the opposite end, using a ⅞-in. drilled hole for starting each cut through the 1¾-in. wall of the tube.

Dual Control Keeps Compressor on the Job

WE HAVE two air compressors that supply air for building-heating temperature control, ice production and other purposes. Compressors operate one at a time and are started and stopped automatically by the air pressure in the system. To divide the work equally, compressors are switched in and out of service twice a day.

Even after careful training of operating personnel we had trouble with failures of the air supply. In addition to instructions, I installed four small air-pressure gages at points where they could be easily observed by the operators. Even this did not do much good, particularly on the third shift.

I then installed another motor magnetic starter and wired one with an automatic pressure switch to each motor, as in the figure. The two pressure switches are both set for the same cutout pressure, but one is set to cut in at a lower pressure than the other. Normally the compressor set to start at the highest pressure cuts in first. If for any reason this compressor fails to start, when the air pressure drops to the setting of the other switch, its compressor will start.



This cured our compressed air trouble.

To divide the work between the two compressors, I connected the two pressure-switch circuits to a 4-pole double-throw switch as in the diagram. When this switch is closed to the up position, one compressor starts first and when down the other starts first.

Since installation of the additional starter over one year ago, we have not had a failure of the compressed-air system, which has justified the comparatively small installation cost.

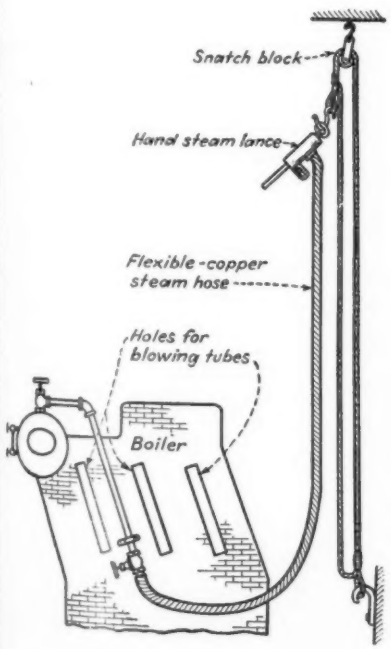
Schenectady, N.Y. CARL BACHMANN

Storing Flexible Copper Steam Hose

IN ONE PLANT where I worked we had three watertube boilers which were cleaned each day by blowing the tubes with a steam lance connected to a flexible-copper hose. The hose, attached to the center-boiler drum, was long enough to reach all three boilers for tube blowing. When not in use we coiled it on a hook on the boiler casing. This practice caused leaks to develop and reduced its useful life.

We eliminated the difficulty by connecting a snatch block near the boiler-room roof. Through this block we spliced an endless rope and spliced in two eyes. In one of them we hung the steam lance, pulled it to the position in the diagram and kept it there by slipping the other eye over a hook attached to the wall. This method greatly increased hose life and splicing the endless rope kept it out of the way.

Great Neck, N. Y. S M ELONKA



Rebuilds Ammeter For New Range

I NEEDED a low-range ac ammeter to connect with a load bank and voltmeter for test purposes. As I could not buy this type I looked around the storeroom and found one with a 0- to 200-amp range that took full current through its coil. It was a repulsion iron-vane meter, with an element easily removed. Its coil had two turns of heavy copper bar connected to large terminal studs that would carry 200 amp.

A 200-amp current in two turns of a coil equals $200 \times 2 = 400$ amp-turns. Since I required a meter of 10-amp range, its coil required $400 \div 10 = 40$ turns. I wound the coil with this number of turns of No. 12 double-cotton-covered wire. With a borrowed ammeter I checked the old meter with its new coil and found that it had a 0- to 9.75-amp range instead of 0 to 10. The new range was sufficient, and with the borrowed meter, I calibrated a new scale for the rebuilt one, in 0.5-amp divisions. This meter is not so sensitive and accurate as a new one, but it serves in the present material and equipment shortage when anything goes that does the job.

Eagle River, Ont. KENNETH COLLINS

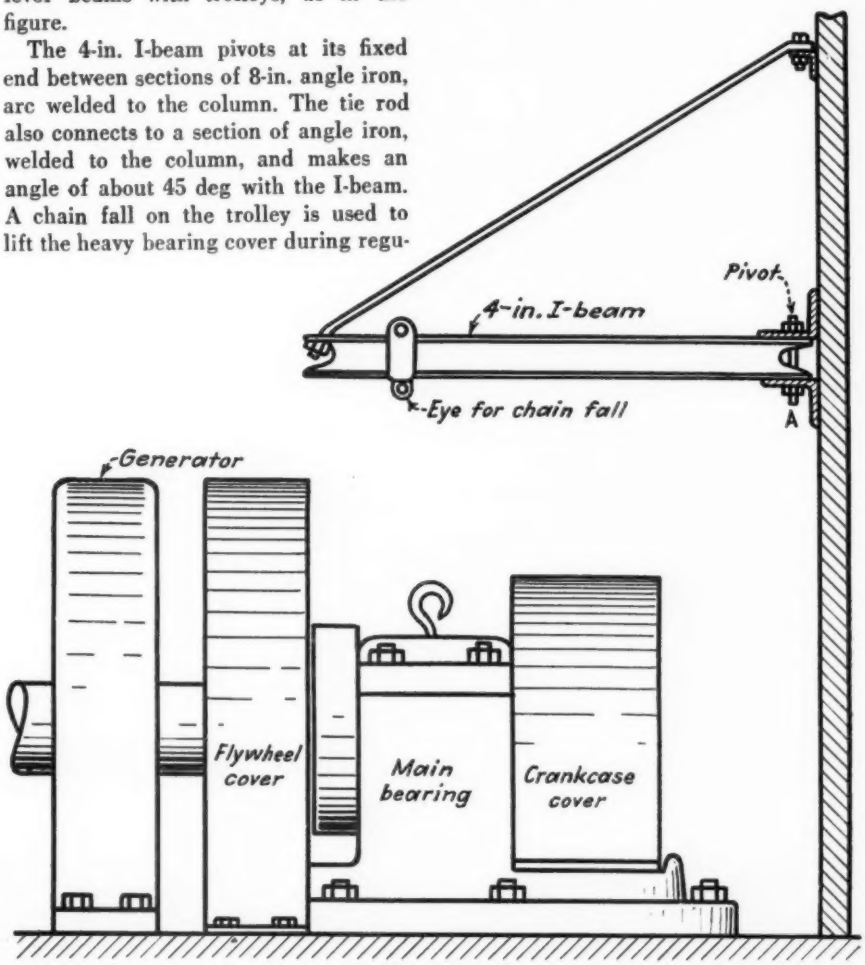
Beam Hoist Helps Make Inspections

FOR EASY INSPECTION and repair, some means should be provided to handle heavy parts of engines, turbines, pumps, compressors and similar equipment. This is frequently done with an I-beam supported over the equipment. The beam carries a trolley to which a portable chain hoist can be attached. Where columns are handy in our plant for supporting them, we have installed cantilever beams with trolleys, as in the figure.

The 4-in. I-beam pivots at its fixed end between sections of 8-in. angle iron, arc welded to the column. The tie rod also connects to a section of angle iron, welded to the column, and makes an angle of about 45 deg with the I-beam. A chain fall on the trolley is used to lift the heavy bearing cover during regular bearing inspections; it has also lifted the engine crosshead and the eccentrics and rods during engine overhauls.

After the parts are lifted they can be easily swung clear of the engine and lowered to the floor onto a truck. When the beam is not in use it is swung from over the engine, out of the way.

Menard, Ill. GEORGE HOLMAN



READERS' PROBLEMS

Questions From Our Readers

Question 1

What Causes This Water Hammer?

Our boilers generate steam at 70 psi. Steam is reduced to 5 psi for heating the hospital buildings which are separated over a fairly large area. Condensate flows by gravity to a low point on the system, from where it is pumped back to the boiler room.

We are troubled with a terrific amount of water hammer in the heating system. What are some probable causes of this condition, and what can we do to put the system in good operating condition?—WH

Question 2

What Is the Secret of This Generator Hookup?

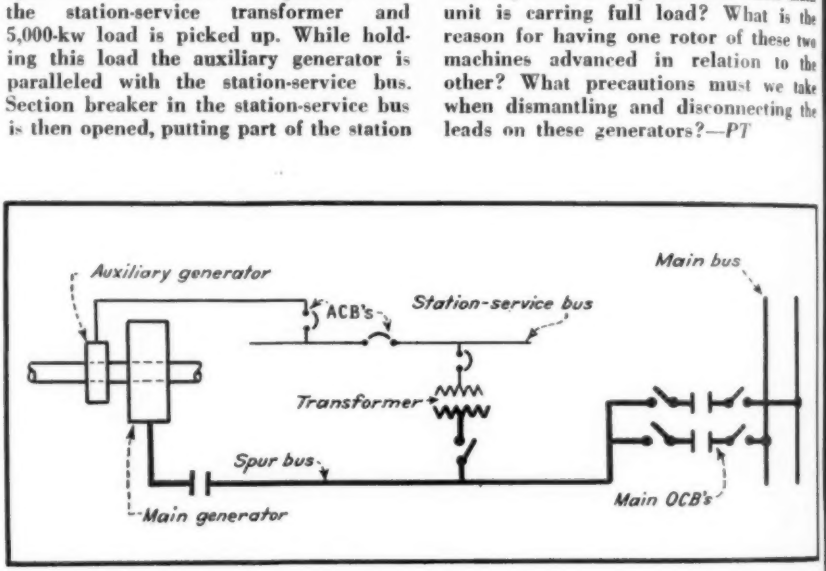
We have a 50,000-kw 13,000-v steam-turbine-driven ac generator which carries a 2000 kw 2300-v station auxiliary ac unit on its main shaft. Main generator leads go through an oil circuit breaker to a spur bus and then through other ocb's to the main powerhouse bus, which feeds outgoing cables and transformer lines.

A 13,000/2300 station-service transformer has its high-voltage winding connected through disconnects to the 13,000-v spur bus. Low-voltage winding connects to the station service bus through an air circuit breaker. Leads from auxiliary generator on the main-unit shaft connect to this station service bus through an acb.

Normal practice is for the service transformer, which is back fed from the main bus, to carry the auxiliaries when main unit is shut down. Upon starting this unit it is paralleled with the system over the spur bus which puts it in parallel with the station-service transformer and 5,000-kw load is picked up. While holding this load the auxiliary generator is paralleled with the station-service bus. Section breaker in the station-service bus is then opened, putting part of the station auxiliaries on the generator and the remainder on the transformer.

If the auxiliary generator can be paralleled when the main unit carries 5000 kw, why can't it be paralleled when main unit is carring full load? What is the reason for having one rotor of these two machines advanced in relation to the other? What precautions must we take when dismantling and disconnecting the leads on these generators?—*PT*

SUITABLE ANSWERS from readers will be paid for if space is available for publication. Answers that are accompanied by rough drawings or photographs will command additional pay.



Answers to Jan. Question 1

What Causes Carryover?

We have 3 hrt boilers connected to a common 14-in. header. Main load for the dye house comes off the top at one end of this header, which is trapped on the lower side. Steam for auxiliaries and finishing room is taken off at other points of the header but the main load is on the dye-house line.

The largest boiler (175 hp oil fired) delivers steam to the header farthest from this main steam delivery line. No. 2 and 3 (125 hp) were until recently oil fired but are now equipped with stokers.

Carryover is heavy and was not corrected by changing from oil to coal firing of No. 2 and 3 boilers. No. 1 boiler is equipped with a steam dome. Dry pipes were inserted in No. 2 and 3 boilers without noticeable reduction in carryover. No. 1 boiler delivers its steam through a 5-in. diameter gooseneck while the smaller boilers have 6-in. lines. Boilers operate at 80 psi and use a hard well water softened by treatment.

There has been no difficulty in building up 18 to 20 concentrations in No. 1 boiler. But concentration seldom exceeds five in the two smaller boilers although water column and blowdown lines are tight so that leakage does not occur at these points. This indicates that heavy carryover from these boilers is not caused by high concentrations because it continues when city water of relatively low mineral content is substituted for well water.

All boilers occasionally carry heavy overload, but in the absence of meters exact load cannot be determined. Low concentrations which occur in boilers 2 and 3 hold the alkalinity down to 10 to 20 grains with total concentrations of 150 to 200 grains. Total concentrations were less when city water was tried.

Would taking the main steam load off the header from a point near where the 5-in. gooseneck from No. 1 boiler enters the header reduce this carryover? I have noticed that in a battery hookup boilers nearest the point where steam is taken away tend to lose water.—BTF

Install Adequate Metering

CARRYOVER CAN BE CAUSED in several ways: (1) overloaded boilers, (2) improper drainage of steam header and lines, (3) too high a water level in boiler, (4) steam-load demand greater than steam supply, and (5) poorly insulated lines in a cool boiler room.

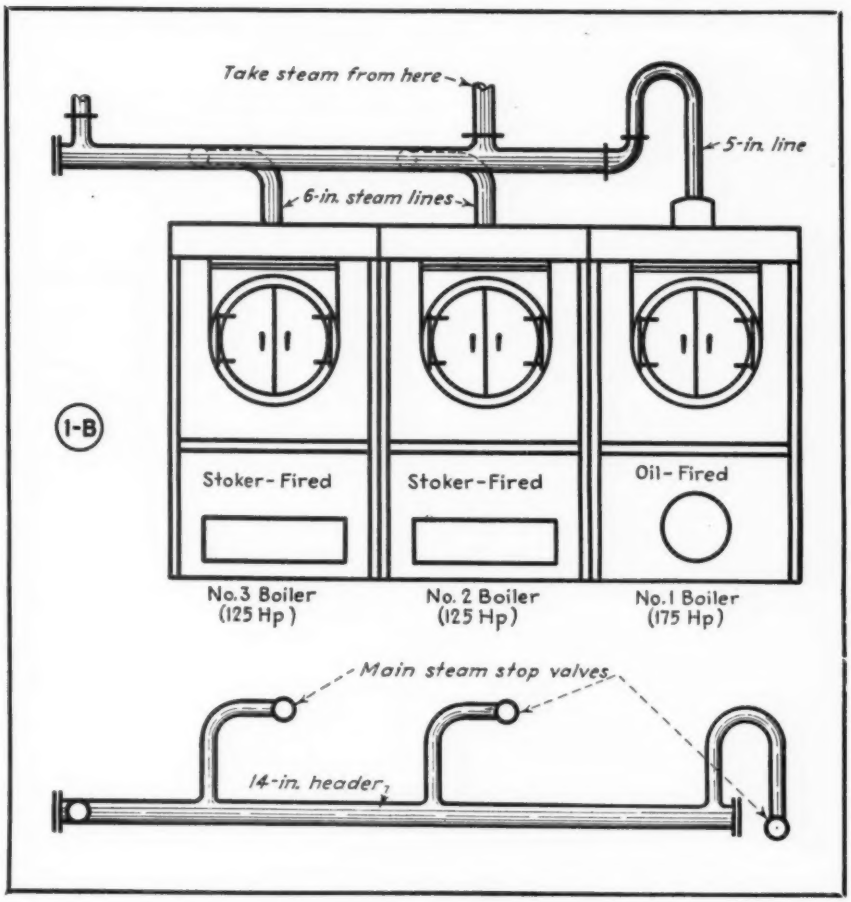
First thing is to make sure of the

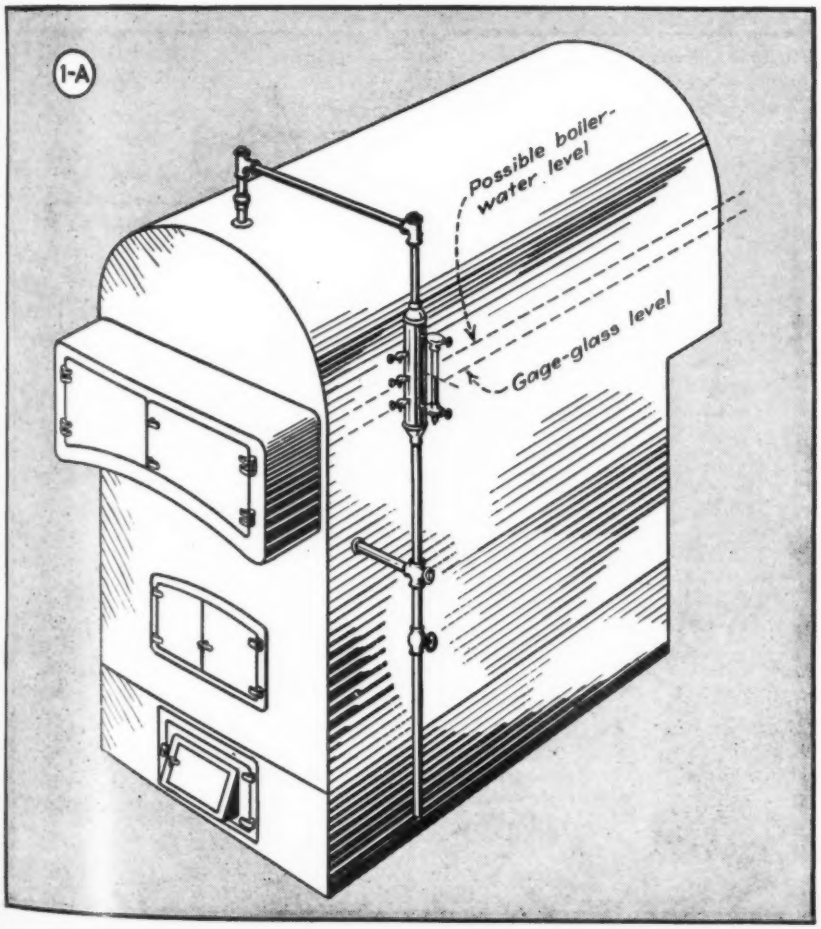
water level. If it is carried too high, that is, over half a gage glass, it should be lowered. Doing this gives a larger steam space and makes drier steam. Then check drainage of steam lines and header. If possible, have each drain line connected to a trap. Repair all poorly insulated lines and eliminate all drafts in the boiler room.

Main steam load can be taken from a point near the middle of the header, as in sketch 1-B. I would change the 5-in. line and gooseneck on the steam dome. If it were possible to increase the size of this line without weakening the boiler's dome, I would install a 6- or 8-in. line. Changing the steam main from one end of the header to the other wouldn't help because taking it off near No. 1 boiler would cause carryover from it on a heavy pull. With the outlet in the center of the header, steam flow is more nearly equalized, and this helps drainage. It would require four drain lines each trapped separately to drain the lines as quickly as possible.

Best advice is to have the power plant metered. Then it would not take long to find and correct the trouble. It probably would mean a few changes but would be worth the money and effort.

Philadelphia, Pa. W T MULLEN





Gage Glass Can Give False Reading

WATER LEVEL in BTF's boilers may be higher than that shown by the gage glass. The glass is merely one leg of a U-tube, the boiler drum itself constituting the other. U-tubes are always in balance so far as the unit weight of the two legs is concerned, but their relative height is determined by their relative density.

There is a difference in density between water in the boiler and that in the gage glass for two reasons: Water in the boiler is lightened by steam bubbles, and it is also hotter. Under extremely heavy firing, steam liberation may cause a difference of 10 to 20%. If the gage-glass fitting connects into the front sheet, communication is so direct that water in the glass is practically as hot as that in the boiler and there is no appreciable difference in density.

Consider a horizontal-return-tubular boiler with its gage-column water connection made to the boiler about 30 in. below normal water level, sketch 1-A. Water column is piped out several inches away from the boiler, and shows a considerably lower temperature than the water in the boiler. The difference

may be as high as 70 F. Water's coefficient of expansion within this range is approximately 0.000643. giving a total expansion of 1.35 in. With steam liberation causing another 10%, or 3-in. increase, the gage-glass level may be low by 4.35 in. Naturally, this is an extreme case but it illustrates a situation that can exist.

Were the dry pipes installed properly? Facing the perforated side toward the water level acts the same as raising the water level a distance equal to the pipe diameter.

It is hard to believe that carryover from either boiler could be serious enough to reduce concentrations this much without actually showing up in much greater feedwater requirements. Try regulating feed by hand to see which boiler requires the most water. With certain steam-header connections. high-velocity steam from the 175-hp boiler may tend to pull water from the small boilers.

Carryover into the dye house may come from condensation in the line and the difference in concentrations may indicate that the 175-hp boiler carries a greater part of the load.

New York, N. Y. L C RINEHART

Small Boilers Overloaded

CARRYOVER in BTF's boilers is obviously caused by forcing them at high rating. It seems that the two smaller boilers are most severely overloaded, thus accounting for the inability to build up concentration.

While considerable money has been spent in changing from oil to stokers, it is unusual not to consider the importance of steam-flow meters. This is a typical example wherein such equipment is considered unnecessary as long as plant steam demand is supplied, no account being taken of production cost per unit.

I assume that the dye house, using large quantities of both well and city water, has a meter through which the city water supply is measured and, no doubt, carefully checked against bills. Surely it is more important to measure boiler output which is many times more expensive than city water. This is the engineer's opportunity to show his employer the boiler room's importance in the production scheme. He must do this by talking in dollars and cents. Without flow meters, boiler output is mostly guesswork.

Operating under present conditions the boiler nearest the dye house always tends to prime in case of sudden steam demand. The reason is obvious. With all boilers feeding into the same header,

(*Continued on page* 146)

Answers to Jan. Question 2

How Is This Pump Trouble Corrected?

We have a 2-stage 500-gpm 1800-rpm 240-ft head single-suction centrifugal pump that has two blind holes drilled in the impeller, as shown in the rotor sketch.

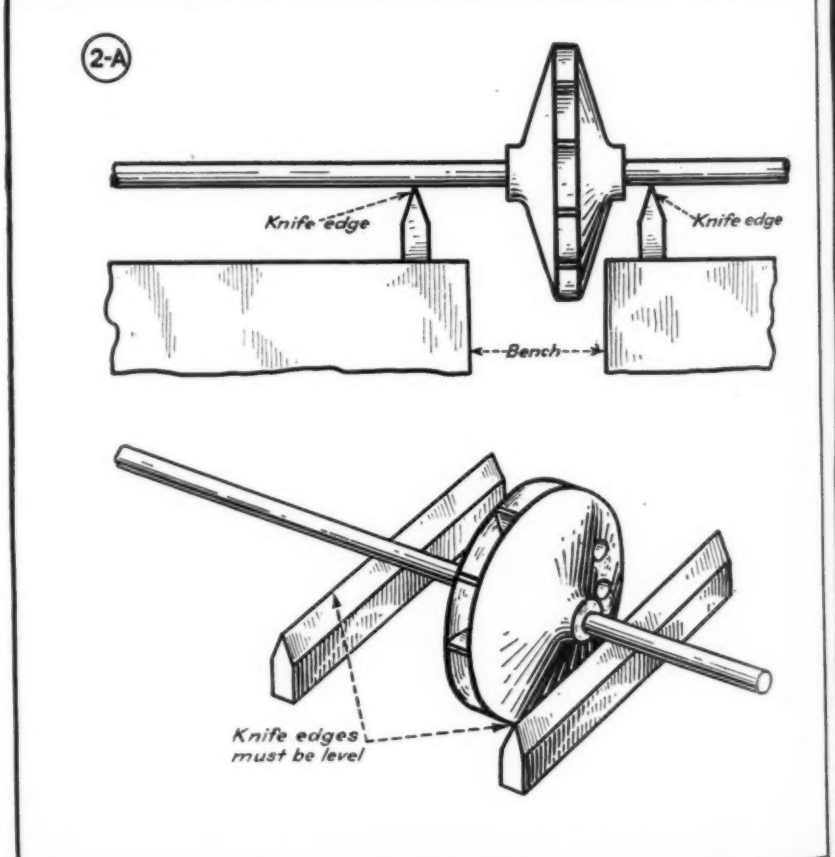
Erosion or cavitation at the two dashed-line areas is serious enough to unbalance the runner. What can we do to correct this trouble? Were these holes originally drilled to balance the runner? Does this cavitation indicate considerable short-circuit leakage around the impeller?

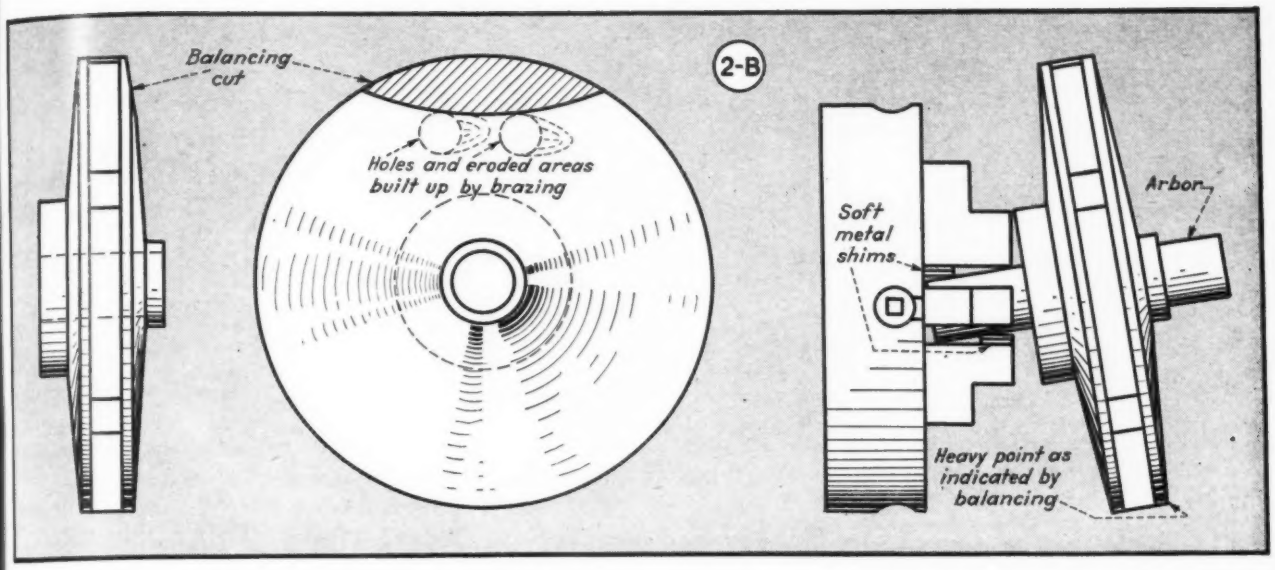
We realize that this area can be built up by brazing but will this concentrated heat injure the impeller? And will this brazing cure the cause of, or just the effects of the trouble?—BJM

Check Pump Suction Line

MOST CENTRIFUGAL PUMPS are designed for a total dynamic suction lift from 15 to 18 ft. If suction lift is increased or available absolute pressure is decreased at the suction opening, the pump's capacity decreases from lack of energy at the suction to create sufficient entrance velocity. Pumps subject to excessive suction lifts wear rapidly, operate noisily, and are subject to cavitation and air binding. Manufacturers design centrifugal pumps for suction lifts higher than 15 ft, but they sacrifice efficiency, and run at lower speeds.

BJM should check the water seal on his pump. Clogged seals allow air leakage past the packing. Some operators pump boiler compounds through the suction side, which causes scale to drop off the casing by slight vibrations set up in the pump. This causes the impeller and stage bushings to wear sur-





prisingly fast, which increases leakage.

BJM should insist upon proper installation of the suction line so that no air pockets develop. (Here, the pump has a single suction, which causes more unbalance than a double suction pump.)

The blind holes in the impeller were probably drilled by the manufacturer or some person responsible for balancing the impeller. Area at the holes can be repaired with little effect on the impeller; however, it must be heated evenly before starting the repair. The impeller can be balanced, as in sketch 2-A, meanwhile removing excess metal by filing or grinding. When the pump is reassembled check its alignment carefully.

Fairview, N. J. M N GOZDENOVICH

Machine Heavy Side Of Shroud

BJM'S TROUBLE is relatively simple and can be easily corrected. He is fortunate in that properly made repairs can prevent the same trouble in future. Apparently, the holes were drilled for balancing. Loss of metal adjacent to the holes does not indicate, and has no connection with, short-circuit leakage around the impeller.

Best solution is to build up eroded areas and holes by brazing, and then rebalance the impeller by machining off a segment of the shroud on the heavy side, as in sketch 2-B. Building up the impeller by brazing should not be difficult, but if there is any doubt about it, consult a reliable manufacturer of welding equipment.

The impeller should then be put on an arbor and any excess material machined off in a lathe. Location of the unbalance can then be determined by mounting the arbor, with the impeller still on it, on a pair of level knife edges. This method of balancing, while apparently somewhat crude, is sufficiently accurate to give satisfactory results for an 1800-rpm impeller. After the heavy side of the impeller has been located and marked, the arbor and impeller can be chucked in a lathe and enough material removed to balance the impeller. Amount to be removed will probably have to be determined by trial and error, although an estimate can be made by putting weights on the light side of the impeller while it is on the knife edges. If possible, it would be well to return it to the pump manufacturer for repair, as his facilities for this work are more satisfactory than in most machine shops.

New York, N. Y. J E LANCASTER

Mill a Rounded Groove

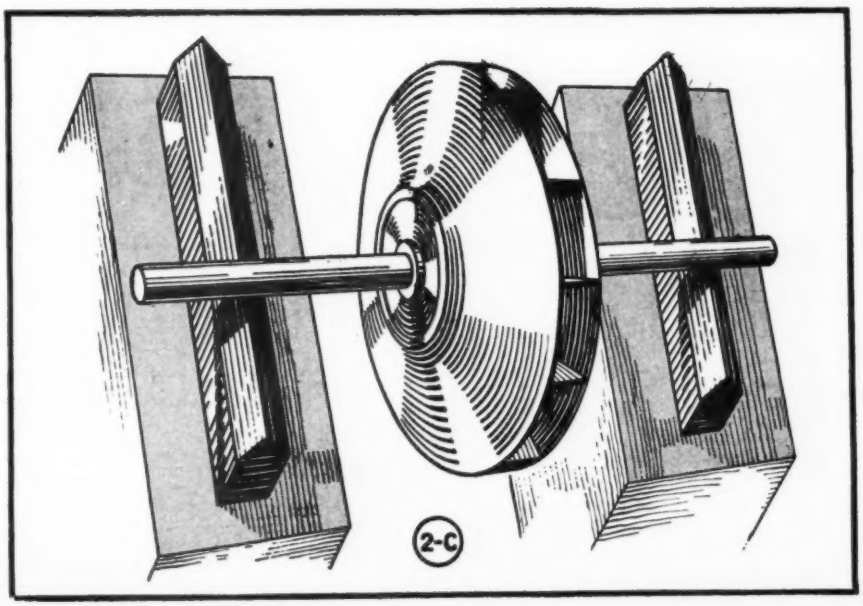
YES, THE HOLES in BJM's pump were drilled when balancing the runner in the shop. This is regular practice when balancing high-speed rotors and flywheels.

However, the possibility of erosion was overlooked. Instead of having the holes drilled the rotor should have been machined out by a milling cutter or by hand tools to give a rounded groove thus streamlining the surface contour and eliminating sharp resistance offered by the edge of the hole.

This cavitation does not indicate an unusual amount of leakage past the seal rings which are not absolutely watertight normally.

The remedy now is to cut the eroded part down to a smooth surface, polish

(*Continued on page* 150)



Q&A QUESTIONS & ANSWERS FOR POWER ENGINEERS

By ALEX HIGGINS

12—*Some Typical Boiler Repairs*

Twelfth in a series that is running in every number of* POWER. *From long experience as a professional and practical engineer, Alex Higgins asks and answers some direct questions regarding power equipment its construction, principle, maintenance, efficiency and safe operation. In outstanding fashion he drills the young power engineer, polishes up the oldtimer's knowledge, helps all comers pass engineer examinations and win certificates of higher grade. Besides being invaluable as a study course for examinations, it is a good review for the chief himself who wants to do a better job.—Editor

Q 1—What kind of high-pressure boiler repairs may be made by electric or oxyactylene welding?

A—Factory welds can be tested and flaws readily detected by X-ray and other forms of testing apparatus. These testing methods cannot be applied easily to the common run of plant repair jobs, so exercise great care and judgment when carrying out welding repairs on high-pressure boilers. In general, it is inadvisable to weld long cracks in plates that are exposed to intense heat or to high-tensile stress, but in many other cases risk of failure is not so great and welding is more convenient than other forms of repair. Because much more depends upon the human factor in welding than in other classes of mechanical repair work, it should be done only by skilled, experienced welders.

Some common defects that may be welded satisfactorily are: short cracks in internally fired furnaces; cracks in stayed surfaces, such as side sheets of waterlegs; cracks in tube sheets; cracks in headers.

Always ask the advice of boiler-inspection authorities before attempting any welding repairs, and follow their instructions closely.

Q 2—When a damaged plate is to be repaired by welding in a new piece, how are the plate edges and patch piece prepared for welding?

A—When the patch is in place, plate edges and patch piece must be beveled to form a vee, which is then filled in with the welding material. If any stays or rivets pass through the part that is cut away, they must be inserted in the same position in the patch plate.

Q 3—How is a repair made if part of the bottom of the shell of a hrt boiler has to be cut out and a patch put in?

A—As the shell bottom is directly exposed to intense furnace heat, and welding would probably not be allowed, the patch has to be riveted. Cut out the damaged part to leave an elliptical or diamond-shaped hole with rounded corners. The patch should be cut to the same shape with sufficient overlap to allow for riveting, bent to the same curvature as the boiler shell, fitted in place inside the shell and riveted to it by rivets of the same diameter as those in the shell joints. The rivet patch should be proportioned to give the patch joint strength equal to or greater than the other shell joints. Edges of plate and patch should be calked.

Q 4—How are cracked ligaments between tubes repaired?

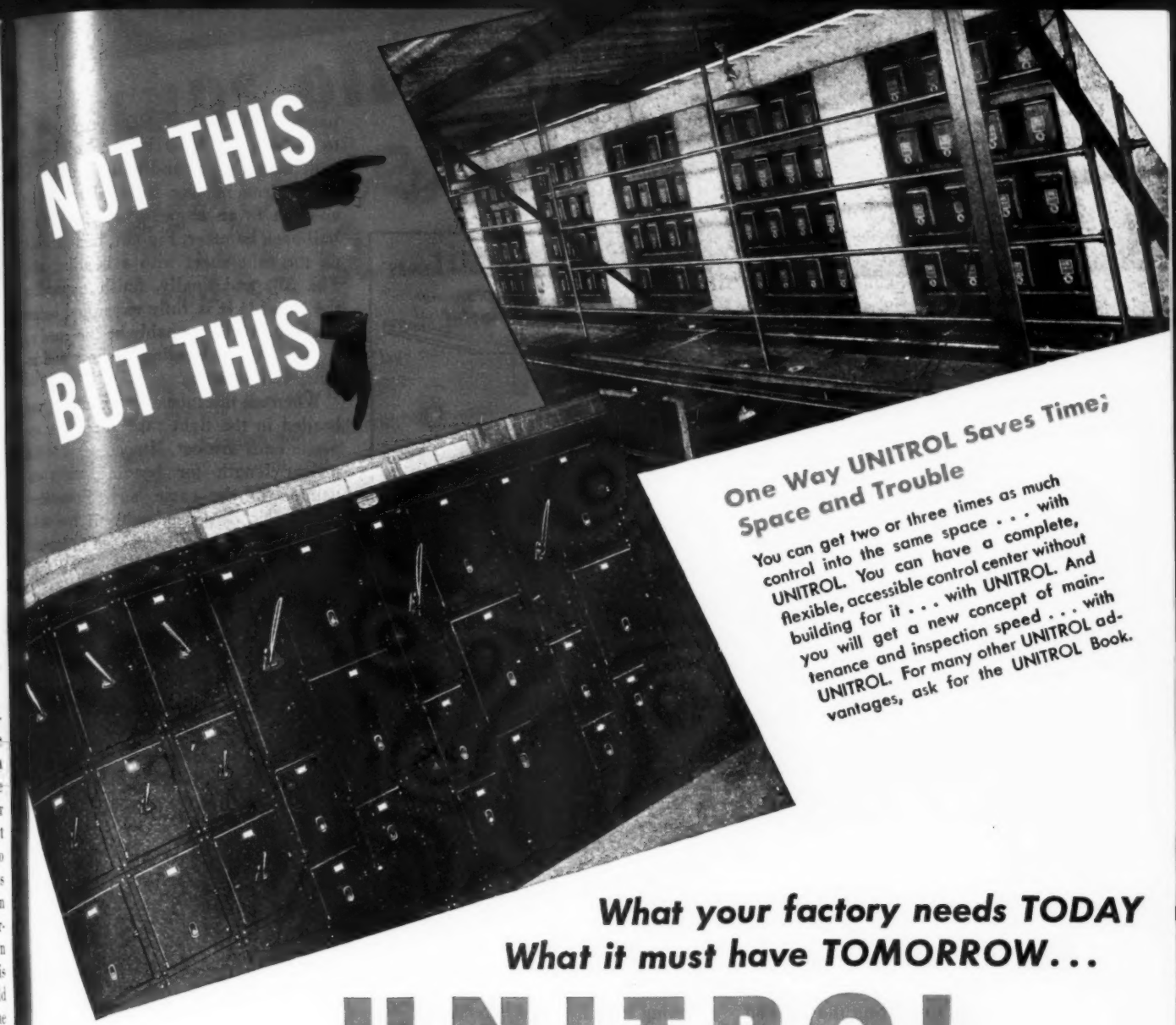
A—The old method was to make a patch plate called a *spectacle piece* because of its shape, and pin or rivet this to the tube plate, over the crack, but now welding does a much better and neater job. Tubes on either side of the crack are removed, the crack vee'd out by chipping or grinding and then welded in the usual way. After welding is completed, edges of the weld in the tube holes and surface of the tube sheet are smoothed by chipping and filing or grinding, and the tubes replaced.

Q 5—What are the advantages of preheating and annealing work that is being, or has been, welded?

A—Advantages of preheating are obvious, especially when large parts are welded. If the metal is preheated to a fairly high temperature, heat from the torch is almost entirely available for melting the filler rod and the metal at the edges of the joint. Preheating also causes the metal to "give" and thus avoids expansion and contraction stresses at the weld or in the surrounding metal. If the metal is cold, on the other hand, heat from the torch is rapidly conducted away by the cold metal and it is more difficult to keep the metal in the joint at a welding heat and do a satisfactory job. Rapid cooling also tends to make the weld metal extremely hard and difficult to chip, file or machine.

Annealing a part after it has been welded allows the strains that have been set up by unequal heating to equalize and adjust themselves. There is also less danger of an annealed part breaking at the weld or close to it when again put in use. Annealing is done preferably in

Attention of readers in the U. S. is called to paragraph A-64, page 201, *ASME Code, Power Boilers, 1940:* **"Where repairs are necessary which in any way affect the working pressure or safety of a boiler, a state inspector, municipal inspector, or an inspector employed regularly by an insurance company which is authorized to do a boiler-insurance business in the state in which the boiler is used, shall be called for consultation and advice as to the best method of making such repairs; after such repairs are made they shall be subject to the approval of a state inspector, municipal inspector, or an inspector regularly employed by an insurance company which is authorized to do a boiler-insurance business in the state in which the boiler is used."**



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Engineering Excellence Finds its Greatest Reward in the Respect and Confidence of those it Serves

Q&A FOR POWER ENGINEERS

(*Continued from page* 114)

a proper annealing furnace where temperature is under close control. If such a furnace is not available, the part may be heated to a dark red and then buried in sand, lime or ashes so that it cools very slowly.

Q 6—How do you remove a defective tube in a hrt boiler if the tube is in the center of the tube sheet?

A—As the tube is surrounded by other tubes, it must be pulled out through the front tube sheet. The beads are cut off both tube ends and the ends split in three or four places by means of a thin round-nosed chisel or a diamond point. Take great care not to cut or otherwise damage the tube sheet. The split tube ends are then closed in a little with a blunt-nosed tool to loosen them in the tube sheets and the tube is driven out of the tube sheet, using a piece of pipe or bar of suitable diameter. If the tube is covered with scale, it may be necessary to use a set of blocks to pull it out through the front tube sheet. Fig. 1 shows the method of ripping the tube end with a diamond-point chisel after the bead is cut off.

Q 7—How do you remove a defective tube in the bottom row of a hrt boiler?

A—You can avoid the laborious job of pulling the tube out through the front tube sheet by cutting the tube off just inside of both front and rear tube sheets, dropping it down and pulling it out through the front manhole or handhole. The ends left in the tube holes are then split and knocked out. This is the fastest and easiest way to remove tubes when a boiler is being retubed. An internal wheel cutter which resembles a tube expander in construction and operation may be used to cut off the tube ends or, if this is not available, a simple hook chisel bar. Method of using this bar is shown in Fig. 2.

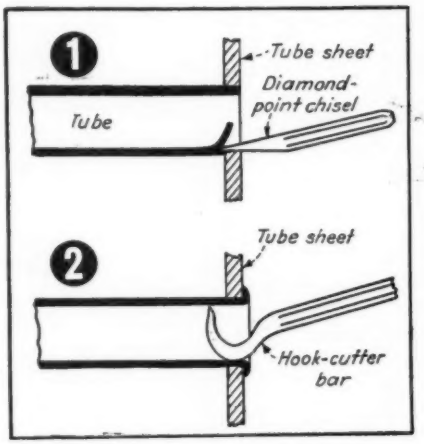


Fig. 1—Splitting the end of tube. Fig. 2—Cutting off the end of tube.

Q 8—What is the correct procedure when putting a new tube or set of tubes in a hrt boiler?

A—After removing the old tube or tubes, the holes in the tube sheet are cleaned and any ragged or sharp edges rounded off slightly. The tube ends are annealed to make the metal ductile and prevent cracking when the ends are being expanded and beaded. In a hrt boiler, the holes in the front tube sheet will be an easy fit for the tubes, and the holes in the rear tube sheet will be a driving fit, unless the holes have been enlarged by excessive tube expanding. In a locomotive boiler, the tubes are a driving fit in the firebox tube sheet and an easy fit in the smokebox tube sheet. Tubes are put in or taken out through the front doors in the hrt boiler and through the smokebox doors in the locomotive boiler.

After the holes are properly prepared, the tube ends are cleaned and the tubes driven into place until the ends project about a quarter inch beyond the tight tube sheet. The tight ends are now expanded and beaded. Best procedure is to tighten the tube in the tube sheet with the tube expander just enough to keep it from moving. Next splay the tube end out to an angle of 45 deg with a ball-peen hammer, Fig. 3A, bead it back on the tube sheet with a beading tool, Fig. 3B, and finally, finish expanding the tube. If it is fully expanded before beading, it will probably be loosened up a little by the beading process and require retightening.

When all the tubes are expanded and beaded in the tight tube sheet, the opposite ends are cut, if necessary, to the proper length for beading, then expanded in the same way. Sometimes beading is dispensed with if the tube ends are not directly exposed to intense heat, as in the smokebox tube sheet of a locomotive boiler. Main object of beading is to prevent the tube end burning off. It is the expanding that really holds the tube in the sheet.

The welding of beads to the tube sheet is also a fairly common practice, especially in locomotive boilers. This cuts down leakage at the tube ends and avoids the necessity for frequent re-expanding which is often characteristic of this type of boiler.

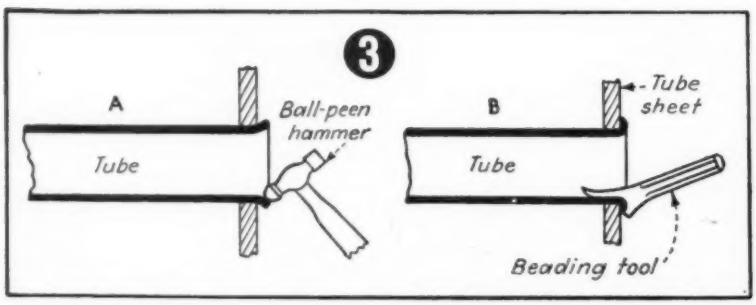
Q 9—Describe a tube expander.

A—The body of a self-feeding roller-tube expander fits loosely in the tube and the rollers are pressed outward by a tapered mandrel, which is turned by a short bar inserted through holes in the head. As the mandrel revolves it turns the rollers. Being set at a slight angle, they have a tendency to feed the mandrel in. The tube is thus gradually expanded until it fits tightly in the tube sheet. Rollers and mandrel must be kept well oiled while the expanding is being done.

Q 10—What should you do when a new tube fits very loosely in the holes in the tube sheets?

A—In an old boiler where leaky tubes have perhaps been expanded over and

(*Continued on page* 140)



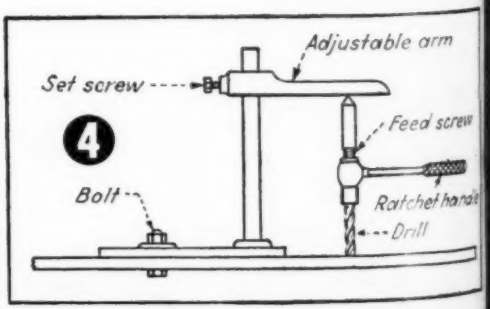


Fig. 3—(A) Splaying end of new tube. (B) Beading end of new tube. Fig. 4 Method of setting up hand ratchet.

SOLNUS OILS

Knock Out Ring Trouble... Carbon!

help reduce "down-time"... cut oil consumption

Top-flight performance of the diesels in this plant was being challenged by excessive carbon deposits and stuck rings.

Production schedules were interrupted because of power shutdowns. All too frequently the diesels had to be taken down to remove excessive carbon. Down-time was extended because of stuck piston rings. Oil consumption was high. Finally they consulted a Sun Oil Engineer, who recommended that they try Solnus Oils.

Trouble took a holiday when the change to Solnus Oils was made. With no mechanical changes in the engines, they ran for six months on Solnus Oils without any trouble. Then they were shut down for a routine check-up . . . disclosing almost complete absence of carbon and freedom from their old ring trouble. In addition, oil consumption was cut 20%.

Full speed ahead is now the order of the day in this plant, with no production delays due to forced power shutdowns. Can you say the same for your plant? Then why not investigate Solnus Oils . . . the oils that are especially made for today's heavy loads. They are low in carbon content, neutral in acidity, wholly distilled and durable. Consult a Sun Doctor of Industry today. Write . . .

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HOW TO PROLONG WELDING-REGULATOR LIFE

STEADY, EFFICIENT OPERATION of a welding torch depends upon how accurately the oxygen and acetylene regulators perform their two chief functions: (1) reduce the high cylinder pressure to the relatively low working pressure, and (2) hold the working pressure constant so that it does not vary the gas supply.

Regulators are sturdy and dependable devices, nevertheless, certain parts do wear out after continued use. Diaphragms lose their original flexibility and valve seats become worn or hard with age—especially those made of relatively soft material.

The welding operator should repair only minor defects; for major repairs, send the regulator to the manufacturer where factory-trained repairmen have the necessary special tools and delicate testing equipment to do a good job.

Most oxygen regulators carry a thin metal disk that ruptures if an abnormally high pressure builds up in the body. When a disk blows, unscrew retaining cap, remove the two fiber washers and disk, clean the washers, insert new disk and reassemble. Never use any substitute for a standard disk.

Never oil an oxygen or actylene regulator because neither requires lubrication even after long service. Oil, in the presence of oxygen under high pressure ignites spontaneously and burns with great violence. Never handle an oxygen regulator or oxygen cylinder with oily hands or greasy gloves.—*Courtesy of The Linde Air Products Co.*

1 **Remove regulators and replace cylinder cap when moving the outfit from one job to another unless cylinders are mounted on a truck. Guard against overturning by anchoring them securely to the wall or a large substantial object; when no other support is available, as a last resort, chain the oxygen and acetylene cylinders to each other, as in 1a. Severe damage to the regulator and cylinder valve can result if a cylinder falls or is pulled over with the regulator attached.**

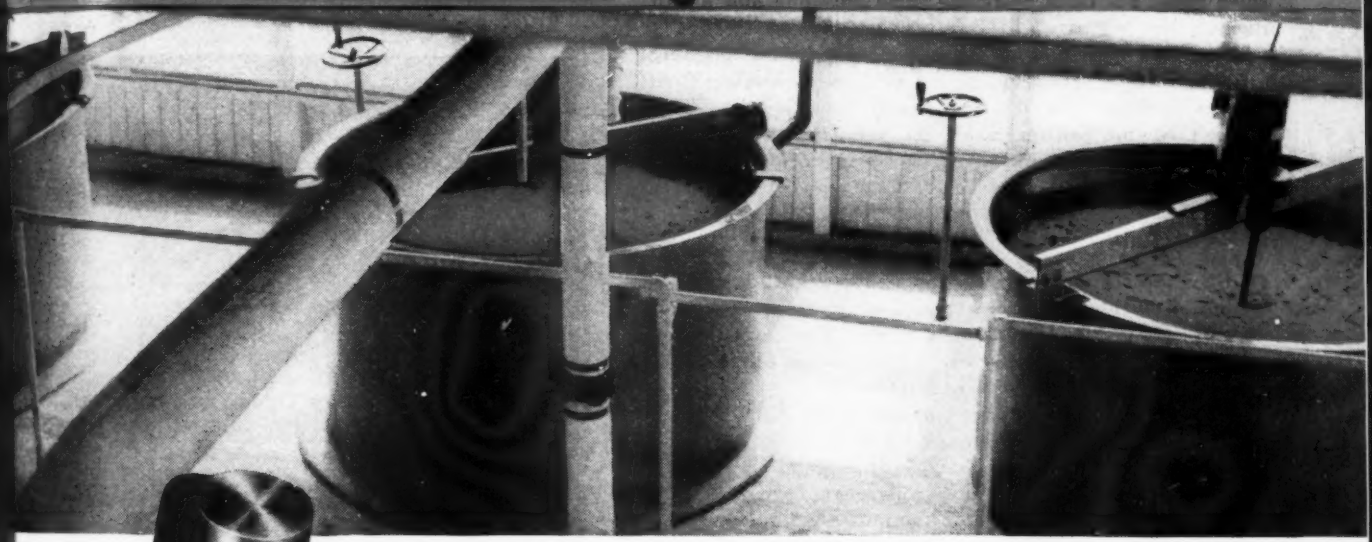
Always keep the dust plug in place whenever regulator is not attached to cylinder, 1b. Replace broken gage crystal immediately to keep dirt out of the delicate mechanism and prevent damage to the gage hand

2 **Before attaching regulator, first, crack cylinder valve (photo) to blow out dirt that might scratch the regulator nipple or prevent making a gas-tight connection between the regulator and cylinder valve. Foreign particles carried into the regulator ruin the valve seat and prevent it closing tightly. A leaking valve shows up by causing the low-pressure gage to creep after the blowpipe valves are closed. If not repaired, the gage mechanism eventually will be severely damaged. Replacing the regulator valve seat or pin usually corrects the trouble. If a new seat is not available, turn the old one over for temporary repairs**

3 **Use the special wrench that comes with regulator for attaching it to a cylinder. Larger wrenches permit using too much force. Applying excessive force when tightening the connection strains or distorts the threads in the nut so that it will not screw on another cylinder freely**

(*Continued on page* 120)

Heating 3200 Gallons of Juice from 70° to 210° *in 7 minutes flat*



KEEPING up with the "tomato season" is a big job for men and equipment—for a ripe tomato can't wait.

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However, a single little 2 inch Yarway Trap on the 2 inch double heating coils of each unit keeps lines free of condensate, and permits bringing the temperature of 800 gallons of juice from 70° to 210° *in seven minutes.* These traps have been in service 4 seasons, giving uninterrupted performance—having replaced other traps unsuitable for this continuous cooking work.

What are your trapping problems? Install a Yarway Impulse Trap or two and let them prove their merits. See how its *small size* saves space. How its *light weight and straight through piping* make installation *easy.* How its *only one moving part,* and its rugged *bar-stock construction,* cut maintenance costs. Then, too, there is *no need to change valve or seat for widely varying pressures.*

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YARNALL-WARING COMPANY, 100 Mermaid Ave., Phila. 18, Pa.

YARWAY IMPULSE STEAM TRAP

HOW TO PROLONG WELDING-REGULATOR LIFE

(*Continued from page* 118)

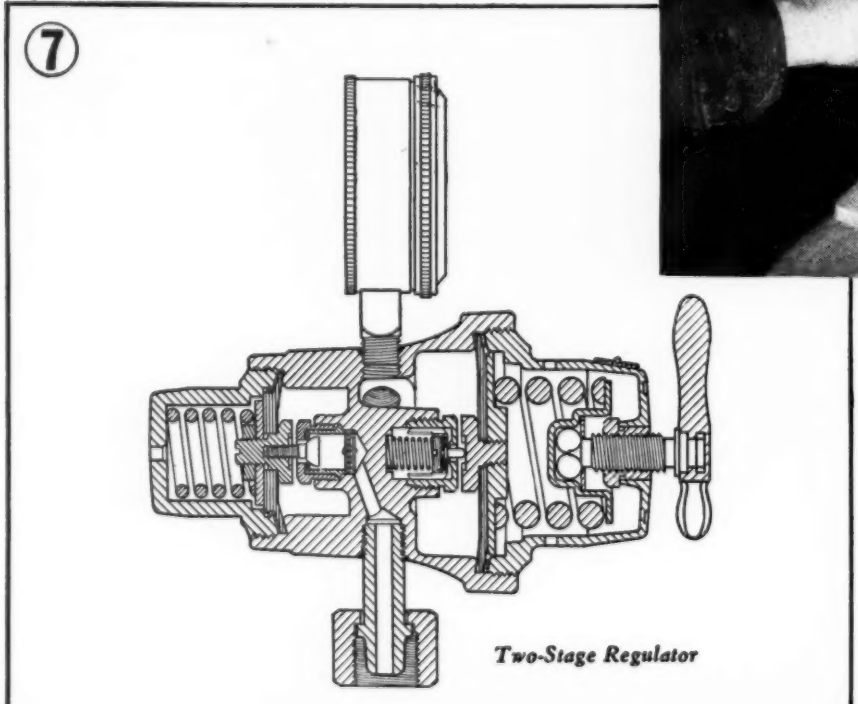
4 If the connection leaks, after using reasonable force in tightening the connection nut, close cylinder valve, take the regultor off, and clean both surfaces of the union seat. Never tighten a leaky connection between regulator and cylinder without first closing cylinder valve

5 Opening the cylinder valve rapidly and allowing a sudden rush of pressure into regulator body may strain or rupture the sensitive diaphragm or spring-gage mechanism. Prevent damage by cracking the valve just enough to raise gage hand slowly. Pressure then builds up without straining internal parts. Next, open oxygen-cylinder valve fully, but open acetylene valve only one and a half turns.

Avoid damage to low-pressure gage when opening cylinder valve by releasing pressure-adjusting screw (Turn counter-clockwise, as in photo, until it is loose.). This closes valve mechanism inside the regulator so that full cylinder pressure cannot reach low-pressure gage

6 Give the regulators a rest for a short time when welding or cutting operations stop. Turn pressure-adjusting screws to the left until they turn freely. Then, open blowpipe valves to relieve pressure in the hose, on the diaphragms, and in low-pressure chamber.

If work stops for a longer period, close the cylinder valve (photo) and open blowpipe valves to drain regulator and hose. Then turn pressure-adjusting screws to the left until they turn freely. Always relieve gas pressure this way before removing regulator from the cylinder



Two-Stage Regulator

7 This regulator reduces the pressure in two steps through two separate and independent valve diaphragms. Full cylinder pressure enters the first stage and is automatically reduced to an intermediate pressure adjusted and set by the manufacturer.

Second stage reduces intermediate pressure to the working pressure required by each size blowpipe. Operator can adjust second-stage pressure

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FOR THE ENGINEERS' BOOKSHELF—

Piping Stress Calculations Simplified *By S W Spielvogel*

How to Pass a Written Examination *By Harry C McKown*

Water-Power Engineering *By H K Barrows*

Diesel Locomotives—Mechanical Equipment *By John Draney*

Plastics *By J H DuBois*

Maintenance Arc Welding *By Jas F Lincoln Foundation*

Piping Design

PIPING STRESS CALCULATIONS SIMPLIFIED (1943) *By S W Spielvogel, mechanical engineering dept, Consolidated Edison Co of New York. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 18, N. Y. 83 pages, 8½x11 in., sketches and numerical examples.* $2.50.

Calculation of stress in steam-piping systems has been restricted to experts up to the present time. Mr Spielvogel has gathered into convenient form all the tables and data needed for most usual pipe calculations and explained the method of calculation so clearly that any high-school graduate can make or check a pipe-stress computation.

By limiting discussion of theory to ten brief pages and illustrating a dozen typical cases with numerical computations, this book makes possible a direct calculation of a pipe problem without study or review of the theory, thus greatly helping those who have occasion to make such computations infrequently. The author has extended the methods and illustrations to three-dimensional piping systems, which were not heretofore available.

Three of the problems have been previously published in POWER (Jan, Feb, and Oct, 1941). Demand for copies of these led to the more complete presentation in book form. Recommended for engineers, draftsmen and all others responsible for high-temperature piping installations.

Passing Examinations

HOW TO PASS A WRITTEN EXAMINATION (1943) *By Harry C McKown, author, lecturer, school activities, formerly professor of secondary education, University of Pittsburgh. Published by McGraw-Hill Book Co, 330 W 42nd St, New York.* 162 *pages,* 8¼x5¾ *in., cloth,* $1.50.

Even though there are no magic devices for walking unprepared into an examination room and coming out with colors flying, there are techniques in thinking, organizing, applying and writing that help you meet a test successfully. And because all examinations are basically similar, most of the pointers in this book apply to any written examination—whether in high school, college, vocation and professional course, Army, Navy or civil service or for an engineering license.

The author backs up his claim that there is no reason to dread examinations by telling how to prepare for them emotionally, physically and mentally.

He gives tips that will help you pass the oldest form of written examination —essay, or subjective, questions. The new-type, or objective, questions are also analyzed carefully. Contrary to popular belief there are only a few basic forms of the latter and once you understand them you can handle most questions in about the same way.

The pointers here will help you considerably if you know your material; 150 definite suggestions are backed up by actual examinations, questions, settings or conditions.

Water Power

WATER-POWER ENGINEERING *(third edition 1943). By H K Barrows, professor emeritus of hydraulic engineering, Massachusetts Institude of Technology, and consulting engineer. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y.* 791 *pages,* 6x9 *in.;* 315 *illustrations;* 128 *tables; cloth binding. Price* $6.00.

Since the second edition in 1934, water-power engineering has made important progress, recorded in this, the third edition. Enlarged from 762 to 791 pages, it follows previous arrangement closely and retains the chapter headings: water-power development—its distribution and use; hydrology; study of steam-flow data and water-power estimates; hydraulic turbines and general arrangement of plant; the dam; the waterways—canals and penstocks; powerhouse equipment—hydraulic and structural; powerhouse—electrical; plant accessories; speed and pressure regulation; transmission lines; cost and value of water power; reports and plant descriptions; also four appendixes: hydroelectric development—outline; report of Red River development; plant descriptions and problems in hydraulic engineering. Chief revisions and additions are in Chapters I, II, IV and XII with other changes in the text. Group I problems at the end of the book are largely new. Other new material increases number of pages by 31.

Diesels

DIESEL LOCOMOTIVES — MECHANICAL EQUIPMENT (1943) *By John Draney, past pres, United Associations of Railroad Veterans. Published by American Technical Society, Drexel Ave at 58 St, Chicago 37, Ill.* 472 *pages,* 5¼x8¼ *in.,* 220 *illustrations, cloth-on-board or semi-flexible cloth binding.* $4.00.

Written by a railroader for railroad men, this book, nevertheless, may prove of interest to stationary engineers anxious to learn more about diesels. Its approach is essentially practical; initial chapters on cycles, combustion, fuel-injection, lubrication, cooling, governors and supercharging are followed by a series of eight chapters, each describing in detail one make of engine and giving instructions for inspection and maintenance. Remaining chapters cover locomotive mechanical equipment—trucks, controls, waste-heat boilers, etc—and operation and servicing of locomotives.

A number of diesel engineers and railroad executives collaborated with Mr. Draney in preparation of this book and of its companion volume, *Diesel Locomotives — Electrical Equipment,* 388 pages, $3.50.

Plastics

PLASTICS *(second edition, 1943). By J H DuBois, plastics department, General Electric Co. Published by American Technical Society, Drexel Ave at 58th St, Chicago, Ill.* 435 *pages,* 5½x8½ *in.,* 203 *illustrations,* 50 *tables, cloth binding. Price* $3.75.

It would not be far afield to say that we are coming into a plastic age, if it has not already arrived, and power engineers find themselves dealing with an ever broadening line of equipment that

(Continued on page 158)

"Buffalo" Forced Draft Fans are designed and built to handle any emergency. Today's fuel shortage is one of them! Through reliability plus flexibility of control to meet load requirements, "Buffalo" Fans enable station operators to "extract" more Btu's per ton—make fuel allotments go further. Today of vital importance to the war effort, dependable "Buffalo" Forced Draft Fans will be delivering this same low-cost, fuel saving service long after newspapers headline "Victory" . . . Engineering data on request.

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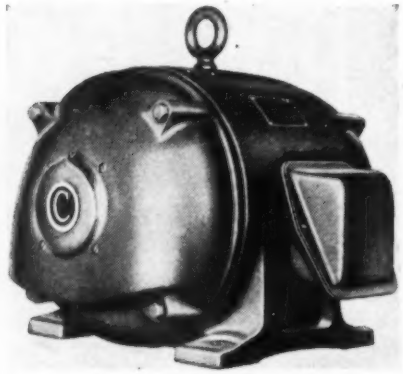
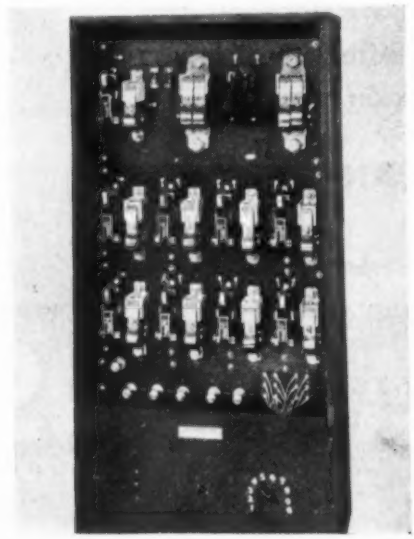
CENTURY FORM J splashproof motors are available in 1½- to 15-hp sizes with 2-way ventilation. Cooling air is drawn in through baffled openings in bottom



of end brackets by a fan on each end of rotor, blown through and around into all parts of motor, and out through louvered openings in frame side below center line and at bottom. Construction is said to protect vital motor parts during plant washdown or for outdoor operation. *Century Electric Co, St. Louis 3, Mo.*

Voltage Selector

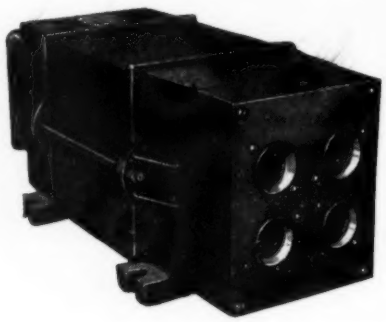
WHILE ESPECIALLY DEVELOPED for a new electroplating process for anodizing aluminum on ac, unit has many other uses where similar applications of current are required. Zenith magnetic selector is for transferring in steps from 2 to 40 v. Arrangement is such that when transferring, the main contact opens before secondary contact opens



and closes after secondary contact is closed. Arcing is thus effectually eliminated. Unit embodies automatic main magnetic contacts and automatic main switch contacts for nine positions at 2½-v intervals, from 2 to 40 v. *Zenith Electric Co, 152 W Walton St, Chicago 10, Ill.*

Portable Transformer

UNDER CERTAIN EMERGENCIES a 110-v current source is important for inspection lights or for small portable tools. Transformer for this service is a 1-kva air-cooled unit, supplied for 440-v primary and arranged with dual-fused secondaries of 110-v each. Transformer may be carried and connected to power line nearest point where 110-v lines are temporarily needed. Receptacles in the



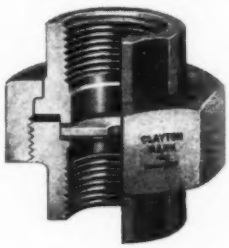
secondary provide fuse protection that may be quickly and conveniently replaced without delay of inspecting main switchboard. *Acme Electric & Mfg Co, Cuba, N. Y.*

Heat Exchangers

IMPROVED BFT-1 sectional-hairpin heat exchangers offers the following advantages, according to maker: (1) Nonremovable rear-end construction permits easy and quick entrance into exchanger for inspection, cleaning, etc. (2) Head seal can be assembled with only an 8-in. crescent wrench, thereby again facilitating inspection, cleaning and easy substitution of one hairpin for another. (3) Exchangers have welded one-piece hairpins, thus preventing any mixing of tube-side and shell-side substances. (4) They have sturdy mounting brackets that are movable to align properly with existing foundations. (5) Fintubes provide high thermal efficiency and troublefree operation. *Brown Fintube Co, 150 Filbert St, Elyria, Ohio.*

Orifice Unions

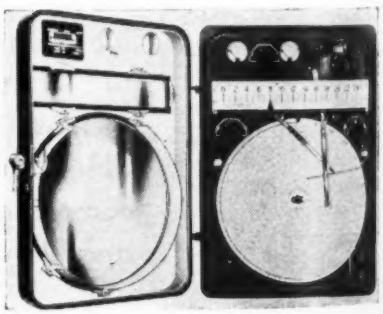
NEW LINE OF ORIFICE UNIONS developed for flow control of steam, air, gas and liquids. These, the manufacturer states, meet the demand for easy-to-install



orifices on steam and hot-water radiation and for bypasses to supply a small quantity of steam to turbines to keep the blades hot during shutdown periods. They may also be used for heavy fluids under pressure to break up and homogenize the fluids. *Clayton Mark & Co, 1900 Dempster St, Evanston, Ill.*

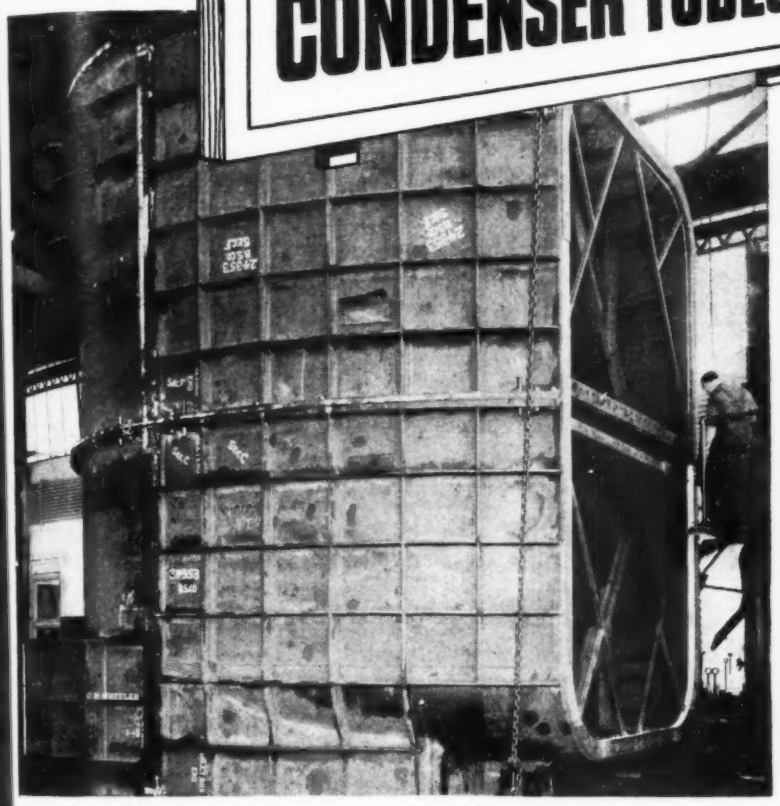
Self-Balancing Potentiometer

MODEL 431 PYROMASTER self-balancing potentiometer has a universal wall or flush mounting case that is deeper than previous Model 440M. Instrument has an internal-hinged panel on which are mounted pen and indicator-drive mechanism, and for electric controllers, control contacts or proportioning slide wire, or for air control, complete new



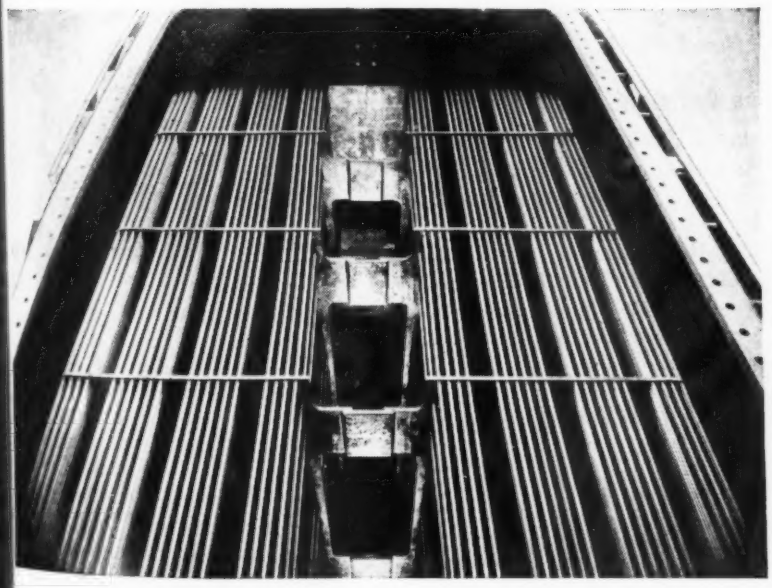
convertible air-operated control mechanism. Deep case and inner panel make it possible to service or replace any portion of instrument without disturbing any other part. It is claimed that heavy-duty pen-drive motor gives more torque for operating control contacts and other similar functions, especially under conditions of poor line-voltage regulation. Indicating scale on indicating-recording model has been changed to a horizontal wide band instead of rectangular-dial design. Stepping relays and slide wire

36½ MILES OF CONDENSER TUBES



Above, Shell for 50,000 square foot surface condenser fabricated by C. H. Wheeler Manufacturing Company.

Below, Anaconda Muntz Metal Tubes, as seen through exhaust opening.



...and every inch must be the same!

Eighty-four hundred lengths of Anaconda Muntz Metal Condenser Tubes provide 50,000 square feet of surface area in this public utility condenser fabricated by the C. H. Wheeler Manufacturing Company.

In the construction of such huge and costly units as this, involving quantities of priority material, selection of the correct tube alloy is of prime importance.

That is why manufacturers of condensers and heat transfer equipment so often confer with Engineers of our Technical Department . . . why Anaconda Condenser Tubes are available in a wide range of alloys.

The experience gained in years of study of tube metallurgy and performance under a wide range of operating conditions, in power plants, refineries, at sea, and ashore in all sections of the country is at your disposal. Publication B-2 lists Anaconda Condenser Tube Alloys, describes their manufacturing processes, compositions and fields of application. We'll be glad to send you a copy. 44101

THE AMERICAN BRASS COMPANY
Subsidiary of Anaconda Copper Mining Company
General Offices: Waterbury 88, Connecticut

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

ANACONDA
from mine to consumer

Anaconda Condenser Tubes

(Continued from page 124)

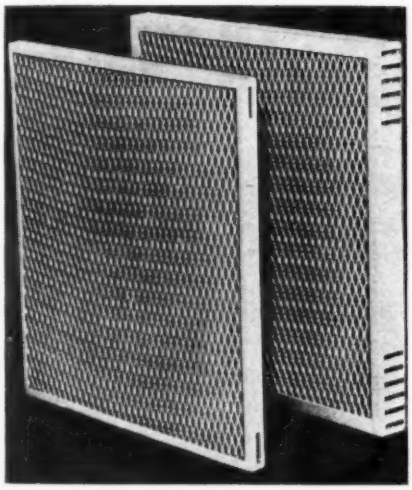
in potentiometer circuit is inclosed in dustproof Bakelite housing and a heavier power supply has been provided. Another change is that a standard cell type of manual standardizing circuit now replaces voltmeter design. *Bristol Co, Waterbury 91, Conn.*

AC Welders

BUMBLEBEE AC WELDERS in all-weather models of 300- and 500-amp capacities. Machines are similar to standard Wilson Bumblebee ac welders, except that they have special moisture-proof insulation throughout and all parts are protected by a heavy coating of moisture-proof paint. In addition, all-weather welder is equipped with a low-voltage contactor which automatically holds open-circuit voltage at approximately 40 v. When operator strikes arc, low-voltage contactor closes instantly and transformer's performance thereafter equals that of machines not similarly equipped. When arc is extinguished, device immediately reduces voltage back to 40 v. *Wilson Welder & Metals Co, 60 E 42nd St, New York 17, N. Y.*

Spring Hanger

PRE-ENGINEERED SPRING HANGER has the following advantages, according to manufacturer: (1) It minimizes changes in pipe-supporting force. (2) All-steel welded construction meets pressure-piping code. (3) Unique swivel coupling provides adjustment and eliminates turnbuckle. (4) Compact design requires minimum headroom. (5) Installation simplified by integral-load scale and travel indicator. (6) Selection of proper size from simple capacity table is easy. *Grinnell Co, Providence 1, R. I.*

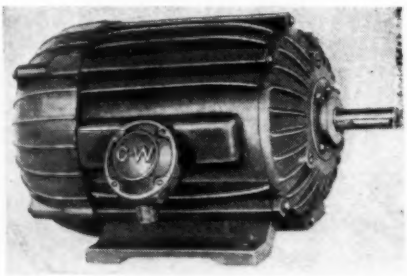


Air Filter

FOR INSTALLATION on all standard dc generator units, impingement filter unit traps all dust particles before they can reach rotating parts of equipment. On any similar motor or generator installation, it doubles brush life and prevents *frozen* or clogged rotors, according to manufacturer. Permanent filter medium is said to have high dust-holding capacity, low air resistance, even when heavily dust laden, and high filtering efficiency. Incased in arc-welded steel frame, it may be removed easily for cleaning. Welder filters in sizes to fit all standard welders and in standard or special sizes adaptable to any machine or equipment. *Air Devices, Inc, 17 E 42nd St, New York 17, N. Y.*

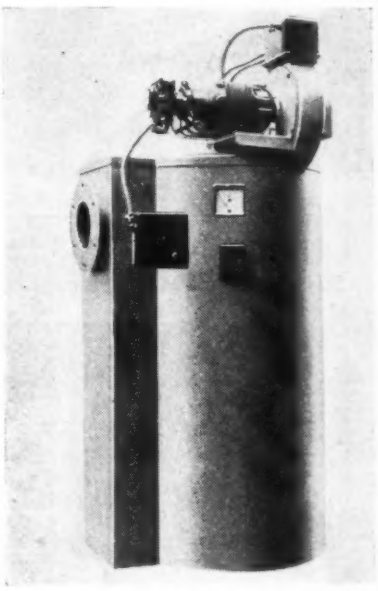
Corrosion-Resistant Motor

MOTOR SUITABLE FOR ATMOSPHERES containing injurious dusts, corrosive vapors or gases and excessive moisture. Available in sizes from 1 to 15 hp, the *Sealedpower* motor may be furnished for operation from any polyphase-power supply. Totally inclosed and fan cooled, design departs from previous models in that there are no cooling ducts to become fouled with wet or sticky dusts. All exposed parts of the corrosion-resistant model are acid and alkaline resistant to a high degree. In addition to the mechanical sealing of entire motor, each coil is individually sealed against moisture, fumes, vapor and dust by vacuum impregnation process. *Crocker-Wheeler Electric Mfg Co, Ampere, N. J.*



Bevel-Gear Universal Joints

PRECISION-CUT manganese-bronze bevel-gear universal joints, with angular range of 0 to 135 deg on vertical center line, or 0 through 360 deg on horizontal center line, for remote control of valves, pumps, engines, antennae, ventilators and other equipment in inaccessible locations, or for centralized control of widely separated units. Joint capacity is from 1580 to 4938 psi at 49 rpm. Joints come in ½- ¾- 1- 1¼- and 1½- in. standard sizes. Special sizes may be ordered. *Condenser Service & Engrg Co, 95 River St, Hoboken, N. J.*



Hot-Water Generator

WHILE DESIGNED especially for marine hot water and heating service, oil-burning, automatic hot-water generator is recommended for land applications. Agitair generator is down fired, with a multiple pass over the heat-absorbing surfaces. Diesel or light fuel oil is burned under positive pressure supplied by a low-speed motor. Combustion occurs in a carborundum chamber through which flame has a corkscrew travel. There are no negative drafts and no smoke, eliminating necessity for special

(Continued on page 166)

From beginning to end you can get it from Crane

One high standard of quality throughout . . . One source of supply . . . One responsibility for all materials

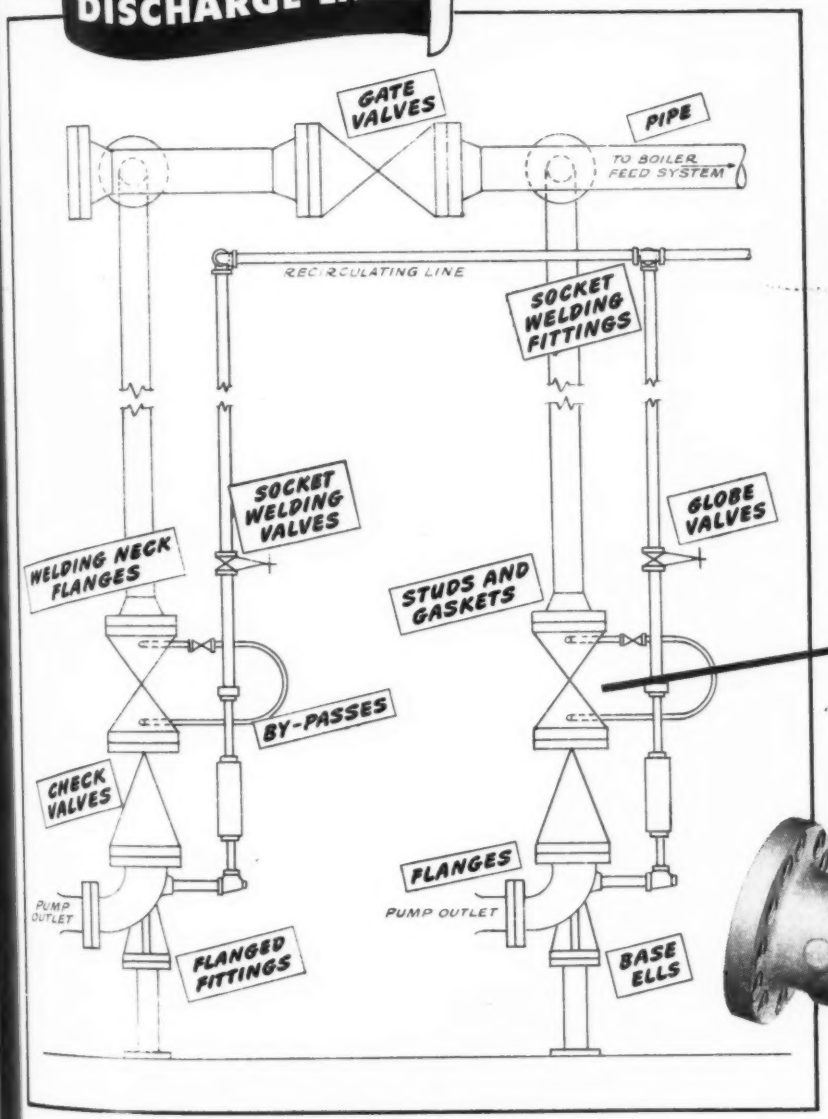
WHEN you need a single fitting or a piping system, you stand a better chance of getting exactly what you need from Crane. The unusual completeness of the Crane line sees to that—as indicated by this boiler feed hook-up. Not only the valves and fittings, but all pipe, pipe bends, and other materials are supplied by Crane.

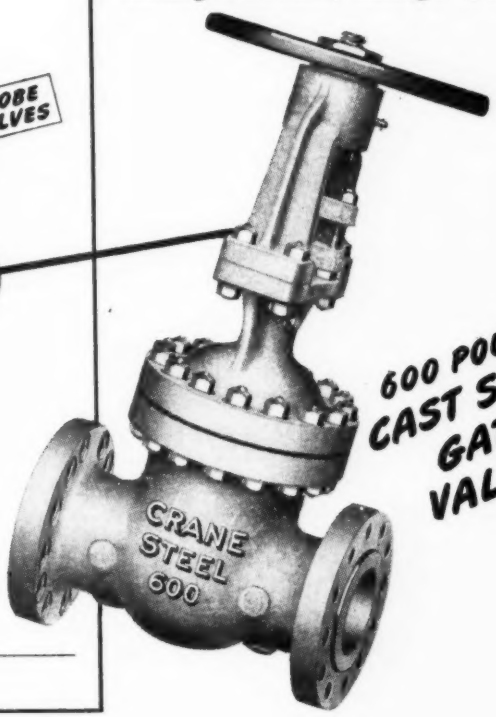
For an example of the superiority of these materials, take Crane cast steel wedge gate valves. Straight-through ports minimize turbulence, erosion, and resistance to flow. Strong tee-head disc-stem connection, easily lubricated ball-bearing yoke, and ample non-corrosive stem bearings assure smooth operation. The disc is fully guided and accurately seated by extra long guide ribs.

Yet all Crane products have similar characteristics of modern design that mean better performance and greater freedom from trouble. Choose all your piping needs from the world's largest selection—with quality assured by Crane Co.'s 89-year leadership in the piping materials field.

CRANE CO., General Offices: 836 S. Michigan Avenue, Chicago 5, Illinois

ON BOILER FEED PUMP DISCHARGE LINES





600 POUND CAST STEEL GATE VALVES

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

GREENER PASTURES . . .

More and more often during recent weeks, I have been asked what I plan, or hope, to buy for my plant when the war ends. At first it was fun to answer—to tell what we had to have, or what we thought we'd like in the way of new equipment.

But now I'm getting tired of answering. So many of the questioners seem to be looking over the fence at the greener grass in the other fellow's yard. They apparently hope that I, or some other one of the thousands they send form letters to, will give them an idea for a brand-new product that only they can make, that everybody wants, and that will cost a lot less than they can sell it for. They expect it to incorporate some plastics, or an electronic gadget or two, or to be a civilized version of a bazooka—anything to be "in step with the times." The whole business reminds me of several years ago, when everything had to be "streamlined," whether there was any purpose in it or not. Every drinking glass, salt shaker, or coal shovel you saw was warped into teardrop shape—because the streamlined train had gotten so much publicity.

I wouldn't mind pulling a rabbit or two out of a hat, if I knew how. Anybody likes to be the father of a humdinger idea, even if he doesn't get credit for it, but it seems to me that this method of planning for the future is cockeyed. Most of the people who write me make recognized products that I, and a lot of other engineers, would give our eyeteeth to get right now. We'll buy them just as soon as we can. Will we have to go to somebody who never made the particular thing before, because the fellow who used to make it will be busy making something else? What about all his experience at making it and selling it, and all the training his organization has? Will that just be tossed overboard to take increased risks in some strange field?

Why wouldn't it be more sensible to seek out ways to make the old product better and cheaper? War experience has undoubtedly brought out some new methods or some better materials that will help. Furthermore, shifting back to familiar ground should be a lot faster and easier than going into production of something very new.

I know manufacturers are hunting postwar products to fill the big plants they've built for war contracts. They're digging like the very Ned to find something to produce to keep all that plant busy. That seems to me to be putting the cart in front of the horse. Their old known product offers a lot better immediate potential—and they already have all the costs and methods on it. They even have some idea of how many can be sold. That immediately gives an idea of the amount of plant needed to produce as much as they can sell. If that leaves plant or building *worth using* still unused, they can go on to added products from there. How about added sizes or types? How about cheaper or more expensive variations? In other words, they ought to be sure all the grass in their own backyard is gone before they take a chance over the fence.

George Edwards
Engineer

Large, convenient size and light weight mean faster installation!

TO make possible speedier, more economical installations of insulating refractory linings, Johns-Manville has developed Insulating Fireblok. Available in four grades, Fireblok are suitable for the same range of temperature conditions as the four well-known J-M Insulating Fire Brick. But, one Fireblok covers more surface than five full-size brick. Note these other features:

Easy cutting and fitting—J-M Fireblok can be easily cut with a saw and shaped with a rasp. Most special shapes can be either shop or field cut from standard slabs, reducing the inventory of special shapes.

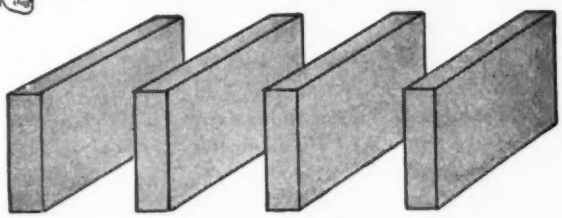
Minimum of Joints—The large size, compared to the standard fire brick unit, materially reduces the number and length of joints, resulting in a thermally more efficient construction.

Economical Bonding—with reduced joint length Fireblok require a minimum of mortar for bonding.

Uses—Fireblok can be used wherever Insulating Fire Brick are recommended. They are particularly suitable for the lining of doors, for suspended arches, and, when tapered, for sprung arches of exceptional stability.

Write for new booklet, IN-103A, on this J-M development. Johns-Manville, 22 East 40th Street, New York 16, N. Y.

"J-M INSULATING FIREBLOK ARE NOW AVAILABLE!"



JM-1620 Fireblok—for exposed temp. to 1600° F. As back-up to 2000° F.

JM-20 Fireblok—for use up to 2000° F. Exposed or back-up

JM-23 Fireblok—for use up to 2300° F. Exposed or back-up

JM-26 Fireblok—for use up to 2600° F. Exposed or back-up

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville INDUSTRIAL INSULATIONS

FOR EVERY TEMPERATURE . . FOR EVERY SERVICE

POWER LINES

Personal notes, items of general interest, the latest from Washington — all the news that is news in the power field

Electricity Serves as Coal in Steam Locomotive

Ordinary old-line steam-switching locomotives can now "burn" both coal and electricity, according to the *Brown Boveri Review*, Baden, Switzerland. The Swiss Federal Railways has installed the necessary electric heaters in one steam switcher and has ordered conversions for two more.

Two transformers mounted on the sides of the locomotive boiler take 16,000 volt power from the overhead lines and deliver 480 kva at low voltage to resistance elements in the form of a tube system through which flows the water to be heated. The article says that no electrical regulating devices of any kind are provided.

To get up steam with electricity takes only half as long as with coal. The locomotives can conveniently work from electrified tracks to those without power, and can use electricity to save coal whenever surplus hydro is available.

FIRE DESTROYS LIBERTY SHIP PLANT

One of Portland's most spectacular fires destroyed, on Feb. 2, the industrial division of Iron Fireman Manufacturing Co, doing an estimated $2,000,000 damage. This plant has been producing Liberty ship engines for two years and held the Maritime M award with a gold star. It had delivered 358 engines prior to the fire; current production averaged one engine a day. Flames destroyed 24 engines, four complete and the remainder in process. The company's present contract called for delivery of 79 more units. Six days after the fire, the Maritime Commission notified Joshua Hendy Iron Works of Sunnyvale, Calif., that it will be awarded the balance of Iron Fireman's uncompleted contract. This came at a time when Hendy was nearing completion of a contract for 681 similar units

Electronic devices are solving two vexing problems in a Southern textile plant:

(1) Photoelectric relays open doors from the warp-sizing room into the weave shed, and close them as soon as a truck has passed through. Closing doors as soon as possible helps maintain much higher humidity and temperature within the weave shed. Also, no one has to open doors for the trucks now.

(2) In the mill's opening room, an electronic time-delay relay shuts down cotton-feeding equipment for a selected period, irrespective of other devices. Here, cotton is removed from the bale, partially cleaned and fluffed up. At times cotton, fed into this machinery, overflowed from bin onto floor so that someone had to replace it in the hopper.

To shut down feeding machinery automatically, a mercury switch trips when cotton in the bin reaches a predetermined level. At this level, the continuously rotating cotton constantly used to trip the switch, with repeated starting and stopping of the feeding machinery while the bin was full. Now, once the mercury switch has initiated a shutdown, the relay keeps the cotton-feeding equipment inoperative for a preselected period, irrespective of opening and closing of the mercury switch. After the time period elapses, the switch again starts the feeding equipment.

Both electronic devices are General Electric installations.

Another giant generator has been put in operation at Grand Coulee Dam, in Washington, to keep abreast of the steadily mounting power demands of **Pacific Northwest war industries.** It brings the installed capacity of the plant to more than 700,000 kw—third largest in the U. S., fourth largest in the world.

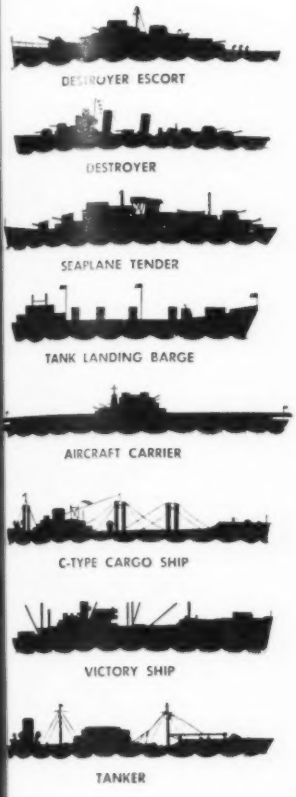
Nearly the entire output of the new mammoth hydroelectric machine, rated at more than 100,000 kw, together with that of six other generators now operating is being transmitted to war plants. The power installed at Grand Coulee during the two years since the first large generator was put in service, and the installations at Bonneville Dam farther down the Columbia River, have been in large measure responsible for establishing major war factories in the Pacific Northwest, Secretary Ickes announced.

Increase in Grand Coulee power capacity is significant from another standpoint. It brings rated capacity of the Bureau of Reclamation's 30 power plants in eleven western states to more than 2,000,000 kw. This installation is equivalent to the total capacity of all

(*Continued on page* 186)

POWER PIPING DIVISION

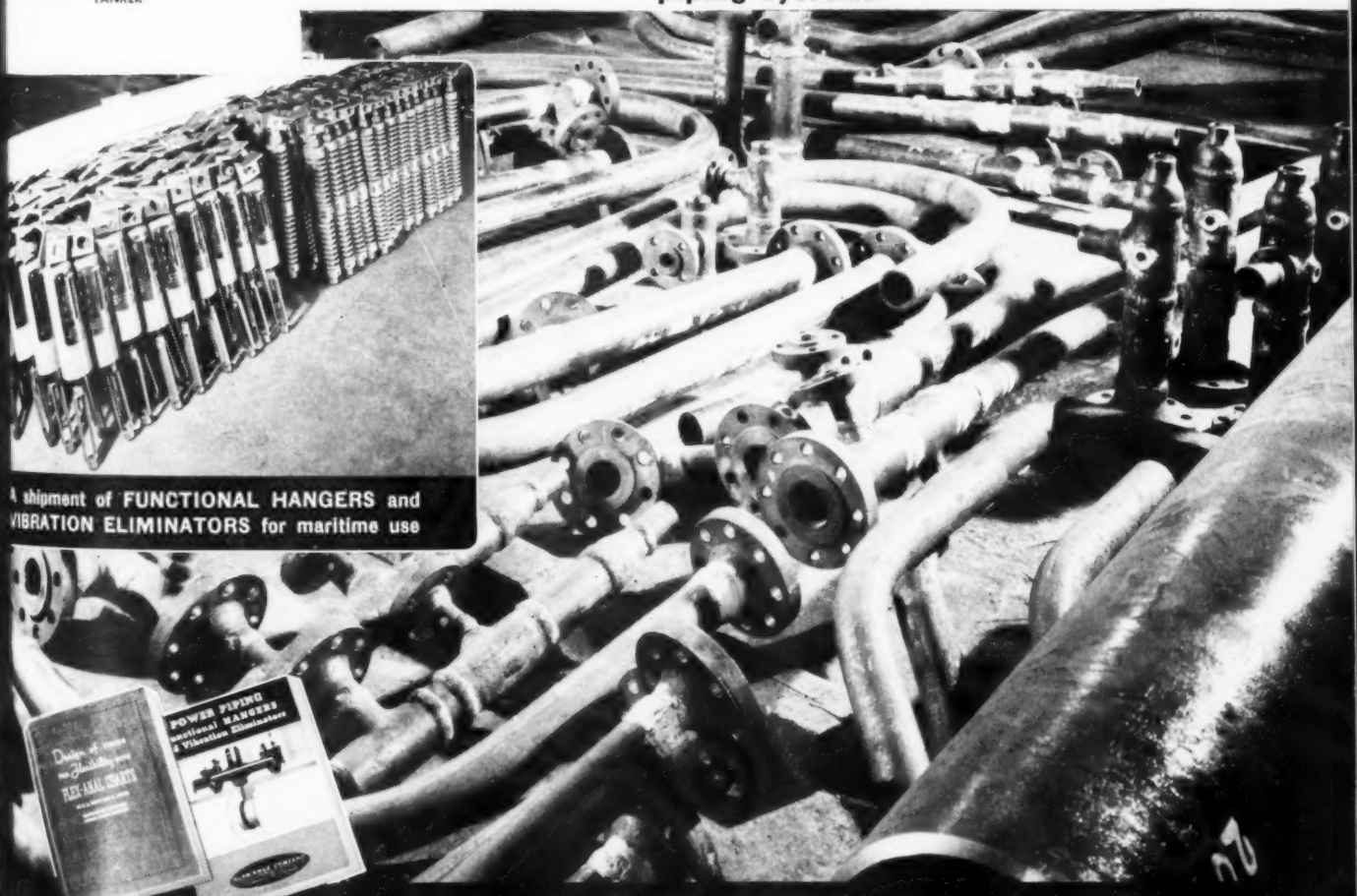
equips the Fighting Ships



America's ship building industry is utilizing fully the facilities of Blaw-Knox Power Piping Division for Engineering and Erection of

- **PREFABRICATED PIPING**
- **FUNCTIONAL HANGERS** for piping support
- **VIBRATION ELIMINATORS** to control the behavior of piping systems

A shipment of FUNCTIONAL HANGERS and VIBRATION ELIMINATORS for maritime use



The correlated use of FLEX-ANAL CHARTS and HANGER BULLETIN 1863 saves time in engineering man power which can be devoted to other useful purposes. Copies of these books can be obtained through a request on your business letterhead.

BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

Prevent Valve Failur

STOP Needless Waste of Service Life with Proper Care of SEAT RINGS

These recommendations cover Globe, Angle and Check valves. Care of Seat Rings in Gate valves will be discussed in another advertisement in this series.

The seat ring is one of the most vulnerable parts of a valve, and neglect, too often, leads to destructive damage. Unless leaks are given prompt attention, "wire drawing" effects are set up and progress steadily, destroying the seat, and often ruining the valve. The trouble may originate from foreign matter jammed on the seat of a closed valve, from "cracking" or throttling valves not intended for that service, from improper discs, or from using the wrong type of valve for the service.

Examine valves at the first sign of leakage, and correct the trouble. If the seat ring is affected, it can usually be restored to full efficiency by regrinding, or, after more serious damage, by refacing. When replacement seems necessary, make sure the ring cannot be otherwise restored before removing it. Too often, rings are replaced prematurely, with a resultant waste of time and scarce metal. Jenkins Valves are designed to permit many reseating operations before ring replacement is required.

Neglect of valves today not only wastes valuable eq ment — it often slows down production of materia gently required by our fighting forces. *Prevent* nee valve failure before it starts — by frequent inspection repair or replacement of worn parts in time to pre valves from destroying themselves — by careful sele of new valves, and installation by experts — by thor training of new men in care and maintenance.

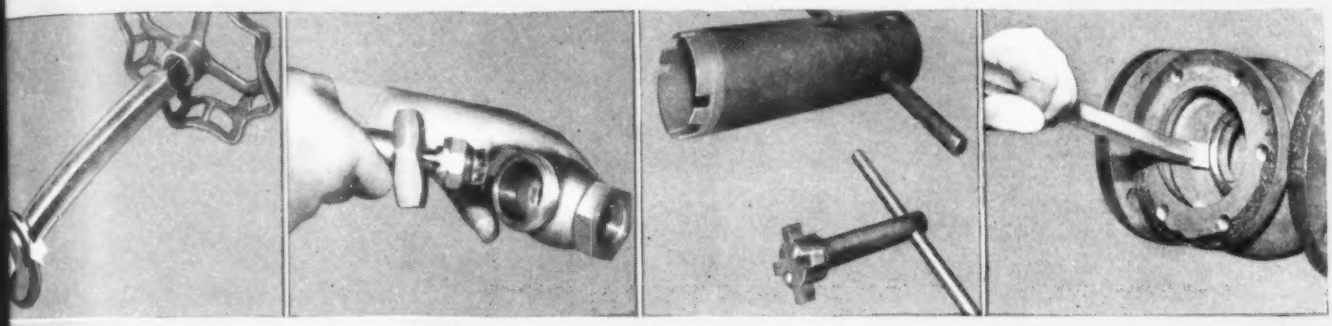
Jenkins Engineers will assist any management in paring an effective program of valve conservation.

Jenkins Bros., 80 White Street, New York 13, N. Y.; Bridgeport; Atlanta; Boston; Philadelphia; Chicago. Jenkins Bros., Ltd., Montreal; London.

JENKINS VALVES

before it starts!

Regrind, Reface, or Replace Seat Rings *IN TIME* . . . End Leaks, Save Metal, Forestall Serious Slowdowns



pect the Seat — make sure it in perfect condition after re-wing the disc in Globe, Angle, Check Valves. In many cases, e seat need only be lapped th emery cloth washers, as il-trated, to remove minor im-rfections. If the face is badly ted or cut, and reseating is cessary, use any of the well-own makes of reseating tools, llowing the manufacturer's in-uctions.

Regrinding is Simple with most union bonnet regrinding type valves. Grinding compound is applied to the disc or plug, and the spindle is used as the tool. Complete directions for regrinding are included in the booklet offered below. In Jenkins Regrinding Valves, the diameter of disc face equals that of seat, to avoid forming "shoulders" in disc after repeated regrinding lowers seat face.

Use the Proper Seat Ring Removal Tools. To prevent damage to valves when removing old seat rings and installing new, use any of the various makes of seat ring removal tools. If none is available, "home-made" tools will serve. Most common is the length of pipe with the end slotted to fit the lugs in the seat ring. Regrind or reface after installation to remove any effects of distortion.

When Rings are Seized, and cannot be unscrewed, cut the seat ring with a hack saw "backed" in two places to prevent cutting through threads. A pinch bar applied against rim of seat, as illustrated, will collapse it for removal. Clean body threads and diaphragm face before installing new seat ring, then apply joint compound to seat ring threads and shoulder to assure a perfectly tight joint.

GET THIS NEW VALVE CONSERVATION HANDBOOK!

32 Pages . . . 80 Illustrations . . . Packed with Valve-saving Suggestions . . . The only book of its kind ever offered.

Jenkins Engineers discuss case records of common valve failures, tell how to prevent needless deterioration and destruction, how to conserve hard-to-get equipment and avoid production slowdowns. Valuable information on valve selection, installation, lubrication, packing, reseating, — on pipe threading, gasket selection, etc. Piping men in every plant should have this booklet. Send for your copy. Fill out and mail the coupon today!

every industrial, engineering, marine and power plant service

RONZE IRON STEEL

JENKINS BROS., 80 WHITE ST., NEW YORK, 13, N. Y.

Please send me . . . . . copies of your valve conservation booklet—"Prevent Valve Failure before it Starts".

Name .....

Position .....

Company .....

Address .....

POWER'S DATA SHEETS

Number 139

Standard Machinery Safety Guard

Moving belts and machine parts need protection against falling objects and accidental interference of all kinds, to guard personnel as well as the machinery itself.

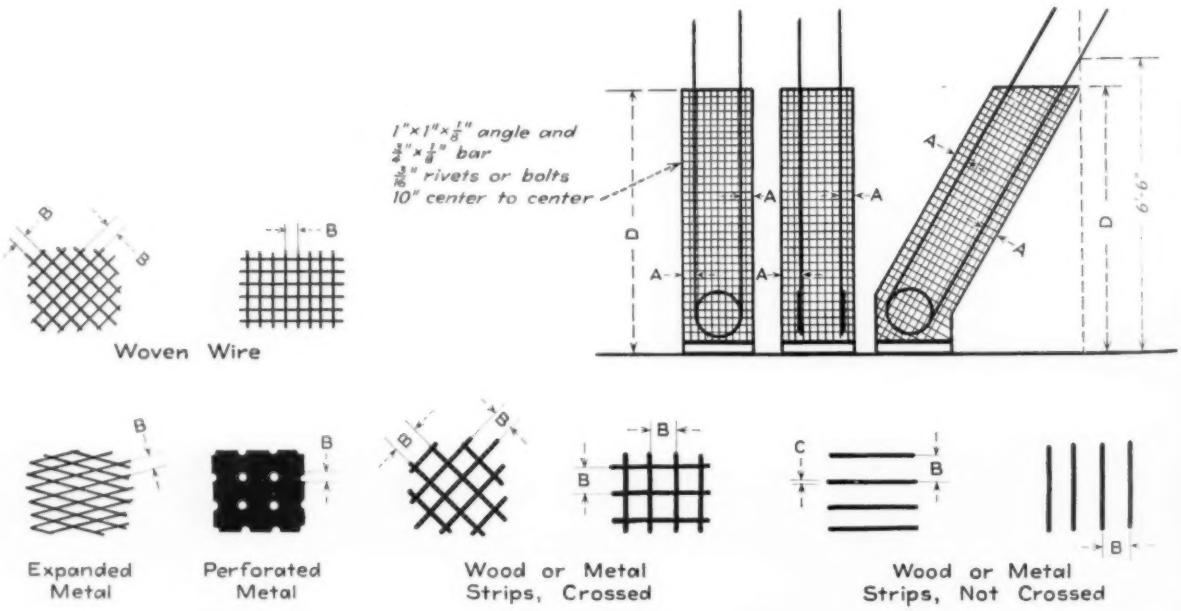
This table specifies minimum sizes of several materials, including wood strips, based on the experience of the National Bureau of Casualty & Surety Underwriters. Guards should be constructed to protect all sides of moving machinery, including side facing the machine.

W E Rossnagel

Minimum Sizes of Materials

Material	*A Clearance at all points*	*B Largest mesh or opening*	*C Minimum thickness or U. S. std. gage*	*D Minimum height above floor*
Woven Wire	Under 4 in. 4 to 15 in.	½ in. 2 in.	16 12	6 ft. 5 ft.
Expanded Metal	Under 4 in. 4 to 15 in.	½ in. 2 in.	18 13	6 ft. 5 ft.
Perforated Metal	Under 4 in. 4 to 15 in.	½ in. 2 in.	20 14	6 ft. 5 ft.
Sheet Metal	Under 4 in. 4 to 15 in.	....	22 22	6 ft. 5 ft.
Wood* Strip, Crossed	Under 4 in. 4 to 15 in.	½ in. 2 in.	¾ in. ¾ in.	6 ft. 5 ft.
Wood Strip, Not Crossed	Under 4 in. 4 to 15 in.	½ in. 1 in.	¾ in. ¾ in.	6 ft. 5 ft.
Standard Handrail	Min. 15 in. Max. 20 in.		1¼-in. pipe or heavier	3½ ft.

* Or metal, No. 16 gage or heavier



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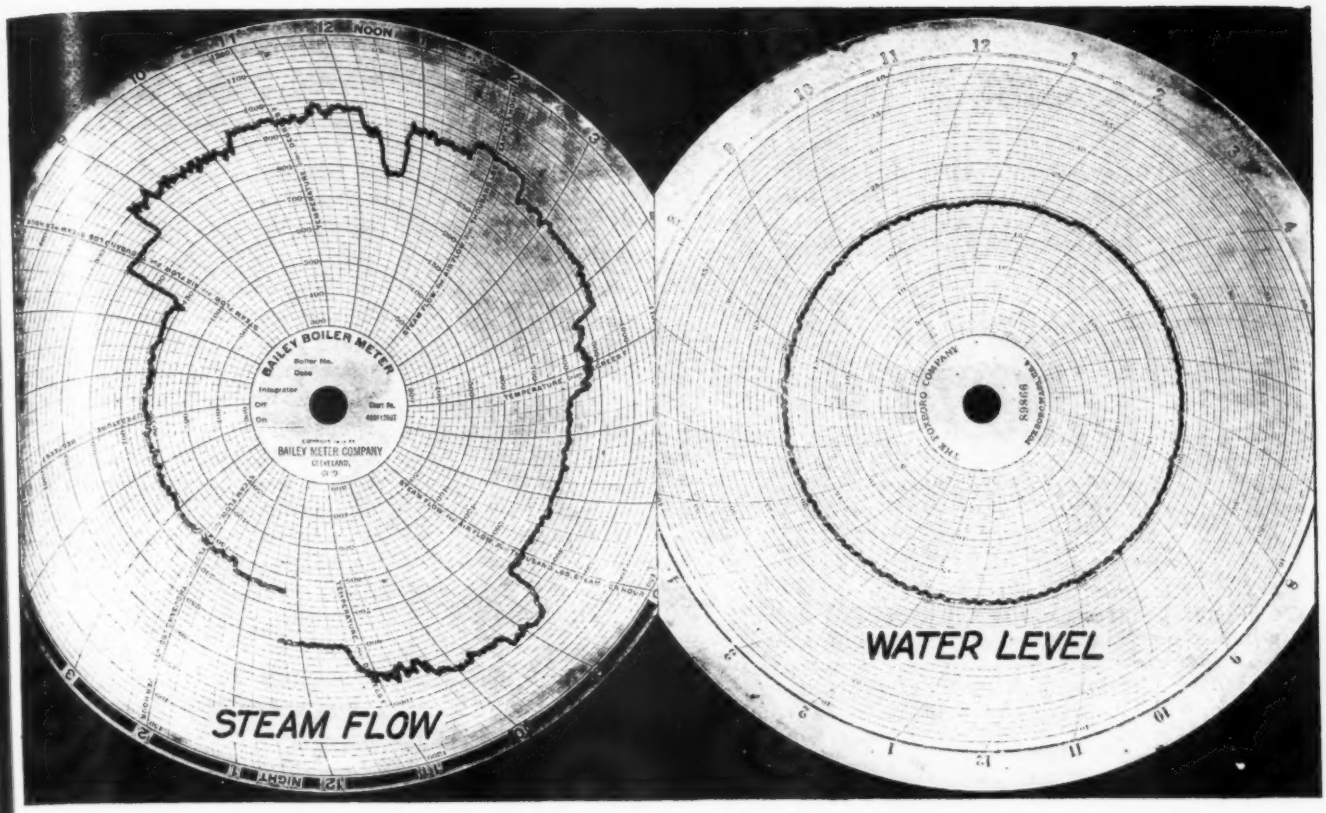


These charts show why 7 plants in this utility system use Flowmatic

This utility system first installed COPES Flowmatic in 1937. Now seven of its plants are using this simplified two-element steam-flow type feed water regulator on 875-pound pressure boilers, with capacities from 400,000 to 550,000 pounds per hour. Nine repeat orders have been placed. The charts show why.

This Foster Wheeler 3-drum boiler normally evaporates 330,000 pounds per hour, with maximum load of 400,000 pounds. Fired with powdered coal, total temperature is 860 degrees F. The motor-driven centrifugal pump has no automatic pressure control, yet the water level is held within less than plus or minus one inch by the COPES Flowmatic.

Want to know how this new COPES operates—where it is used—what results others are getting in regular service? Then write for Bulletin 429. It's worth your study!

NORTHERN EQUIPMENT COMPANY

341 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

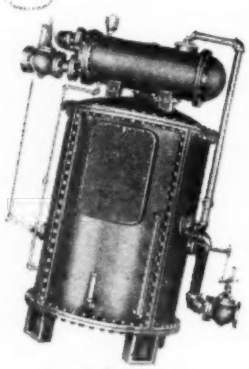
★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC REGULATOR ★

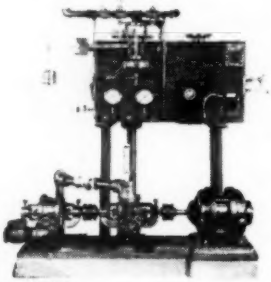
FEEDS BOILER ACCORDING TO STEAM FLOW•AUTOMATICALLY

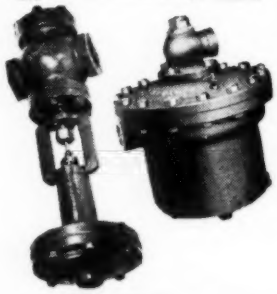
Stepping up Production in the FOOD INDUSTRY

and Other Industries Using Steam for Processing

● Giving canning plants correct drainage for coil-equipped tanks and jacketed kettles, making possible maximum cook room production is a most important part of Stickle service—but only a part. In addition, Stickle service provides for salvaging B.T.U.'s in condensate removed from tank coils and kettle jackets by returning it under pressure, directly to boilers with a temperature loss of only 15 to 20 degrees under steam at operating pressure. This saves up to 20 per cent. of fuel and supplies a proportionate increase in boiler capacity. To make the service complete, there are Stickle Open Coil Heaters for heating and purifying raw make-up water (see Bulletin No. 117) and Stickle Valves for reducing and regulating pressures. (See Bulletins Nos. 235 and 435.)







HANDLE HEAVY VOLUMES OF CONDENSATE

Stickle Steam Traps are widely used in the canning industry because: (1) The Stickle Open Float principle of construction assures natural, positive action in a trap free of complicated internal mechanism—supplying dependable operation and long service. (2) Stickle Traps are designed in series to meet the definite needs of specific operating conditions. They remove the heavy volume of condensate encountered at the start of a cook as rapidly as the lighter volume toward the end of a cook. There is no period of sluggish drainage. See Steam Trap Bulletins Nos. 315 and 515.

SAVE UP TO 20 PER CENT. FUEL CONSUMPTION

Fuel saving with Stickle complete drainage and return, over open tank discharge, is approximately 11 per cent. in B. T. U.'s conserved in condensate. This is increased by elimination of flash steam waste and great reduction in use of raw make-up water. Further savings in maintenance of boilers and steam lines. (Higher operating pressures increase savings.) Ask for Bulletin No. 250.

All Stickle Equipment is built for adaptation to laundries and dry cleaning plants, chemical plants, sand drying plants, milk drying plants and other industries using steam at medium and high pressures for drying, evaporating and other processing.

Stickle

STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE • INDIANAPOLIS, INDIANA

SPECIALIZING FOR 40 YEARS IN REDUCING THE COST OF STEAM

Digester-Gas Engines

(*Continued from page 67*)

of buildings and the sludge digesters.

Power for Bowery Bay plant comes from two sources: the gas-engine-driven generators and the Edison Company network, with no connection between the two systems. The former supply power from their bus to two blowers and a large and a small main sewage pump. Two blowers and two main pumps connect to the utility power bus as do all auxiliary motors and the plant-lighting system. Under normal operating conditions the gas-engine-driven generators should supply all power for the main pumps and the blowers, with purchased power supplying all auxiliaries and lighting.

Heat recovery and heating form one of the interesting features of this plant. Waste heat is available in engine exhaust, jacket water and lubricating oil. Heat is required to keep the temperature in the digesters at 85 to 90 F to speed the process and thus obtain the maximum amount of gas. It is also needed for service-water heating and for building heating in cold weather. Two hot-water systems supply building heating: a high-temperature system in the main building and low-temperature system in other places.

Waste Heat Recovery

In the Bowery Bay plant design, careful consideration was given to waste-heat recovery and its utilization and disposal. As a result practically all heating required in the plant (approximately 97%) is derived from this source. Only in extremely cold weather does it become necessary to provide supplementary heat from a fuel-fired boiler. Handling waste heat may be divided into two main problems: In winter the plant operates for maximum heat recovery, in summer much heat must be disposed of otherwise.

Fig. 3 is a diagram of the engine-cooling water and heat-recovery and disposal system. Assume winter operation, when the jacket-water coolers are by-passed. Engine-jacket cooling water at 115 F is taken from the suction header by the circulating pumps and discharged through the lubricating-oil coolers and the engine-cylinder jackets. This water leaves the jackets at 125 F, goes through an exhaust-gas water heater and leaves at 150 F. Part of it then goes to the digester-water and low-temperature heating-system heat exchangers. When passing through them

Now Ready...

A Bigger Plant

A Bigger Reservoir of Skill

All discussion of post-war planning makes one fact sharply clear. The world-wide call for Diesel power after hostilities cease will be tremendous —for new enterprises, for rebuilding and because of obsolescence.

The Busch-Sulzer organization will be well equipped to play its part in the world rebuilding program. Since America entered the war our facilities have been greatly expanded and, within the last 18 months, our trained personnel has been increased by 50 percent.

At present we are working 'round the clock on Navy ammunition hoists, Diesel engines for minesweepers, net tenders, ocean-going tugs, U. S. Maritime Commission ocean-going cargo ships and smaller vessels and stationary engines for high priorities only.

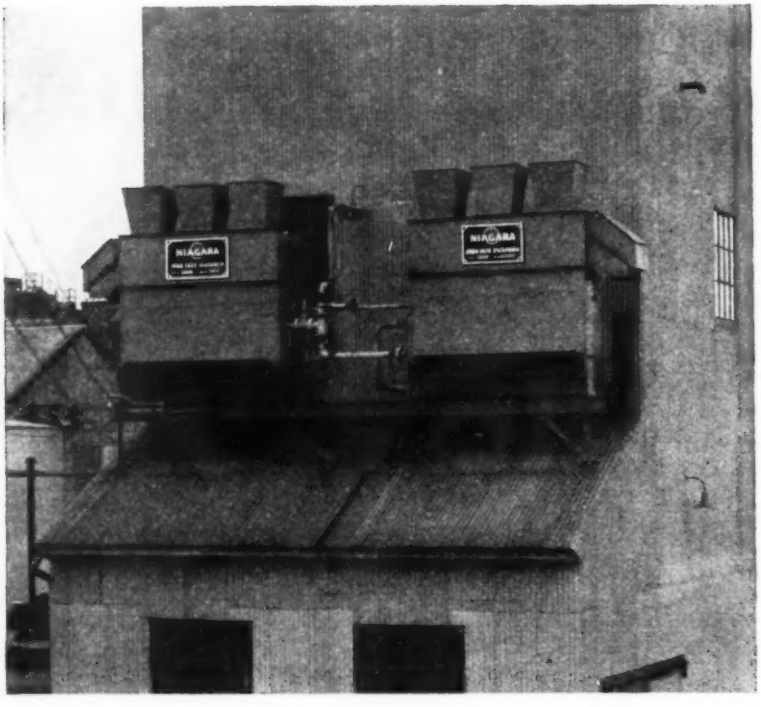
When the war is won, work can begin at once upon peacetime projects without long delays for retooling or training. Busch-Sulzer Diesel engines, in unit sizes from 450 BHP upwards, offer a wide range of speeds for different classes of service or drive. They are noted for their low fuel consumption, reliability and long life.

BUSCH-SULZER ST. LOUIS

BUSCH-SULZER BROS.-DIESEL ENGINE COMPANY
SAINT LOUIS

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

For Lower Costs and Dependable Results in LIQUID COOLING



● Wherever there is a need for the use of cooling water or the cooling of any liquid to exact temperatures, the NIAGARA *AERO* HEAT EXCHANGER provides a more accurate control and lower costs for cooling. Refrigeration is not needed.

These results are advantageous in all types of water-jacketted and water-cooled equipment; for example, they have solved for many the troubles coming from excess water and oil in air compressor lines. Other uses include the cooling of diesel engines and hydraulic equipment; also chemicals and intermediates requiring cooling or controlling temperatures in chemical processes.

In addition, wherever used, it saves practically all the expense of cooling water and the cost of piping, pumping and extra equipment. Users have cut such costs as much as 95%.

Write for complete information

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its temperature is reduced to 11[illegible] F and the digester-heating and heating-system water is increased from about 100 to 130 F. After the jacket water passes these heat exchangers it goes into the return line.

The remainder of the 150 F circulating water goes through the high-temperature heating-system heat exchanger and to the return line. If the water temperature in the return line is above 115 F, enough of it is passed through the jacket-water cooler to maintain 115 F in the suction line.

Each exhaust-gas water heater has a bypass. To prevent formation of corrosive acids that would attack the heaters, this bypass is adjusted so that water flow through the heater will not reduce the gas temperature below dew-point.

During the summer when heating requirements are small a large part of the engine-jacket cooling water goes through the jacket-water coolers. Large quantities of city water are saved by using effluent from the final settling tanks to cool the engine-jacket water. After passing through the coolers the effluent flows to waste.

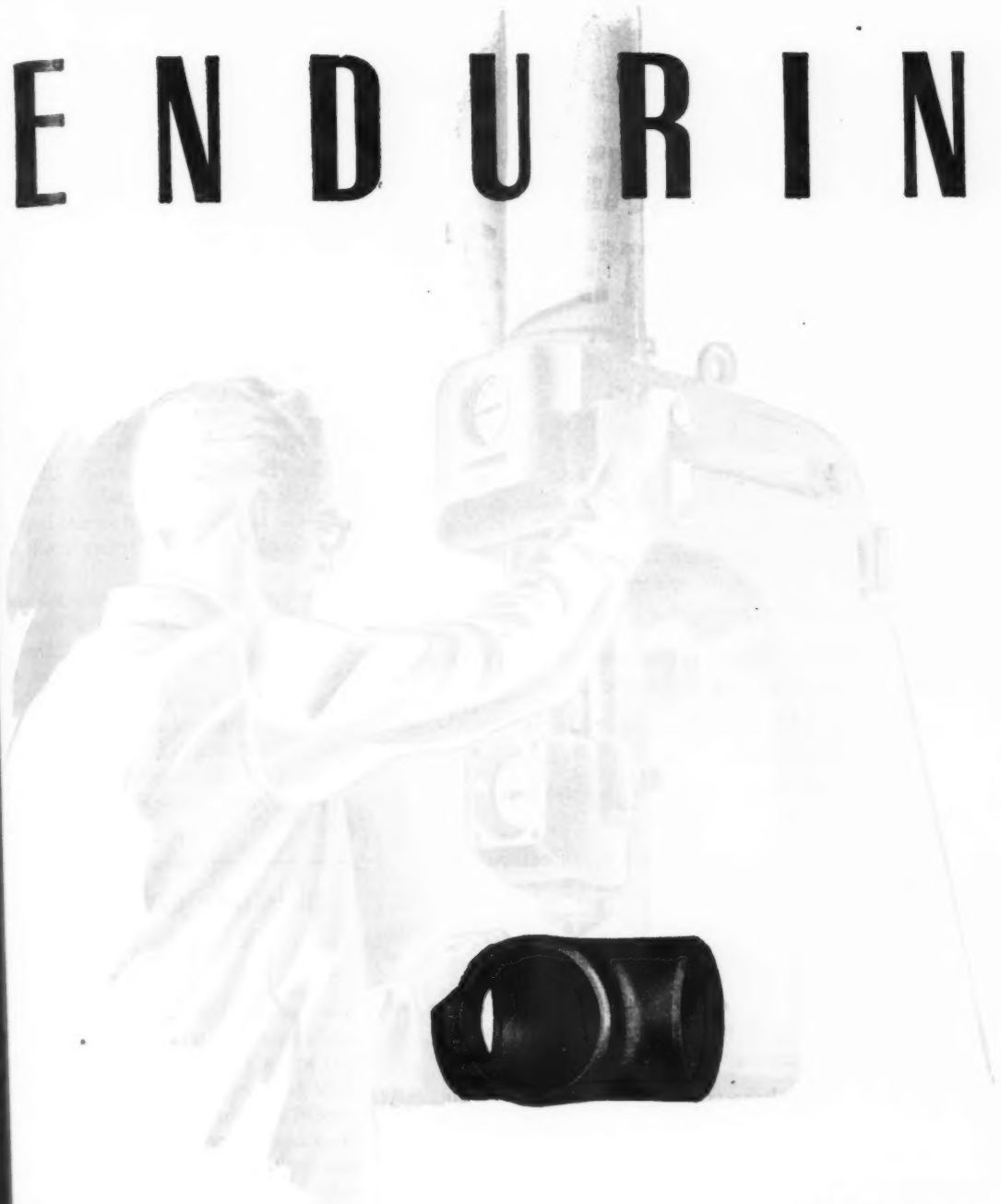
Heating Boilers

During extremely cold periods either one of two oil- or gas-fired 15-psi boilers supply additional heat. This does not amount to more than 2 or 3% of total heat requirements each year. The boilers were installed to burn oil normally. Because of the oil shortage they have been equipped to burn digester gas, with oil as an emergency fuel. The boilers supply steam to three steam-to-water heat exchangers, one on the low-temperature heating system, one on the digester-water heating system, and another on the high-temperature heating system. These heat exchangers, like the others, are arranged so that they can be connected in series in their respective heating lines, or bypassed.

The piping system is of necessity quite complicated, because of the heat-recovery system and the close regulation of the engine-jacket cooling water and digester-heating-water temperature. Keeping engine-jacket-water inlet and outlet temperatures within close limits avoids condensation of hydrogen-sulphide in the crankcase which might be responsible for the formation of corrosive acids. Keeping digester-tank temperature close to the most efficient value insures maximum gas production.

Heating requirements of a large modern sewage-treatment plant present problems quite similar to those in an industrial plant supplied with heat and power from a steam plant. In an indus-

ENDURING



The BRINELL testing machine, shown above in Tube Turns' laboratories, scientifically determines the hardness, or wear resistance, of finished fittings.

Endurance is indispensable in welding fittings, for the destructive forces in piping — strain, pressure, vibration, corrosion and erosion — are more *highly concentrated at the fittings.*

Tube Turns' exclusive manufacturing process forges fittings which virtually eliminate premature wear, leakage, and maintenance throughout the life of piping. Systematic hardness tests *insure* the enduring qualities possessed by all Tube-Turn seamless welding fittings.

TUBE TURNS (Inc.) Louisville, Kentucky. *Branch Offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle . . . Distributors located in all principal cities.*

ARMY E NAVY M

TUBE-TURN

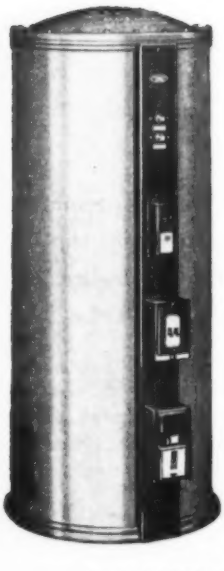
TRADE MARK

Welding Fittings and Flanges

JUST because you have not had a Bearing Failure or some other major disaster do you honestly believe that you've not had any trouble with *dirty or contaminated Turbine Oil?*

To be honest with yourself . . . do a little checking.

- ☐ How does the overall efficiency of your Turbine compare with its peak efficiency?
- ☐ Have you had any difficulty with heat transfer in cooler pipes?
- ☐ Do the oil lines deliver a full supply of oil to bearings?
- ☐ Are the relays reliable and effective . . . have they ever failed?
- ☐ Have you ever scored a bearing?
- ☐ Is the oil temperature increase across bearings excessive?
- ☐ Do you have to shut down your turbine to remove accumulated contamination from oil?



Any or all of these troubles may be the result of contaminated lubricating oil and you are kidding yourself if you think these troubles cannot be overcome by effective oil purification.

A Honan-Crane "Continuous" Oil Purifier will remove contamination from the lubricating oil as fast as it is liberated and provide a constant supply of clean, color clear lubricating oil. You can establish a regular program of purification that will allow you to remove all impurities and keep the steam emulsion number and neutralization at the exact level to give you the safest and most effective lubrication possible to obtain.

FOR COMPLETE INFORMATION WRITE FOR BULLETIN 300

Honan-Crane Corporation
1200 SIXTH AVENUE, LEBANON, INDIANA

trial plant, winter heating requirements utilize all exhaust steam from the power-generating units and maybe some live steam during extremely cold weather. In summer, heat required for service water and process purposes may be quite small, therefore a large excess of exhaust-steam heat must be wasted to atmosphere; similarly, in sewage-treatment works that generate power with sludge-gas engines. In winter, heating requirements utilize all available waste heat from exhaust gas, jacket-water and oil coolers and may require some steam heat. During off-heating periods large quantities of available heat must be wasted in cooling water.

The Bowery Bay Sewage Disposal Plant was constructed under the supervision of and is operated by the Department of Public Works, Irving V A Huie, Commissioner.

For assistance in preparing this article, POWER *is indebted to Wellington Donaldson, chief, Bureau of Sewage Disposal Design; J Frank Johnson, director, Division of Operation and Construction; Nathan I Kass, chief, Bureau of Sewage Disposal Operation, and James T Hogan, superintendent, Bowery Bay Sewage Disposal Plant.*

Questions and Answers

(*Continued from page* 116)

over again, the holes in the tube sheets may become enlarged to such an extent that a new tube will be a very loose fit. Here the new tube should not be expanded out until it tightens in the tube sheet as this stretches the tube too much and weakens it so that it will not remain tight.

Fill the space between the tube and the tube sheet with a thin metal bushing called an "outside ferrule." Ready-made seamless copper ferrules can be bought for this purpose. If they are not easily procurable, a thin strip of copper plate, flattened to a taper at the ends and bent in a circular shape so that the tapered ends overlap, does very well. The ferrule is driven into place between tube and sides of tube hole, and the tube is then expanded and beaded in the usual way. Inside ferrules are sometimes driven into the ends of old leaky tubes as a temporary means of stopping leakage. However, they reduce the tube area and interfere with cleaning.

Q 11—How do you remove and replace a defective staybolt?

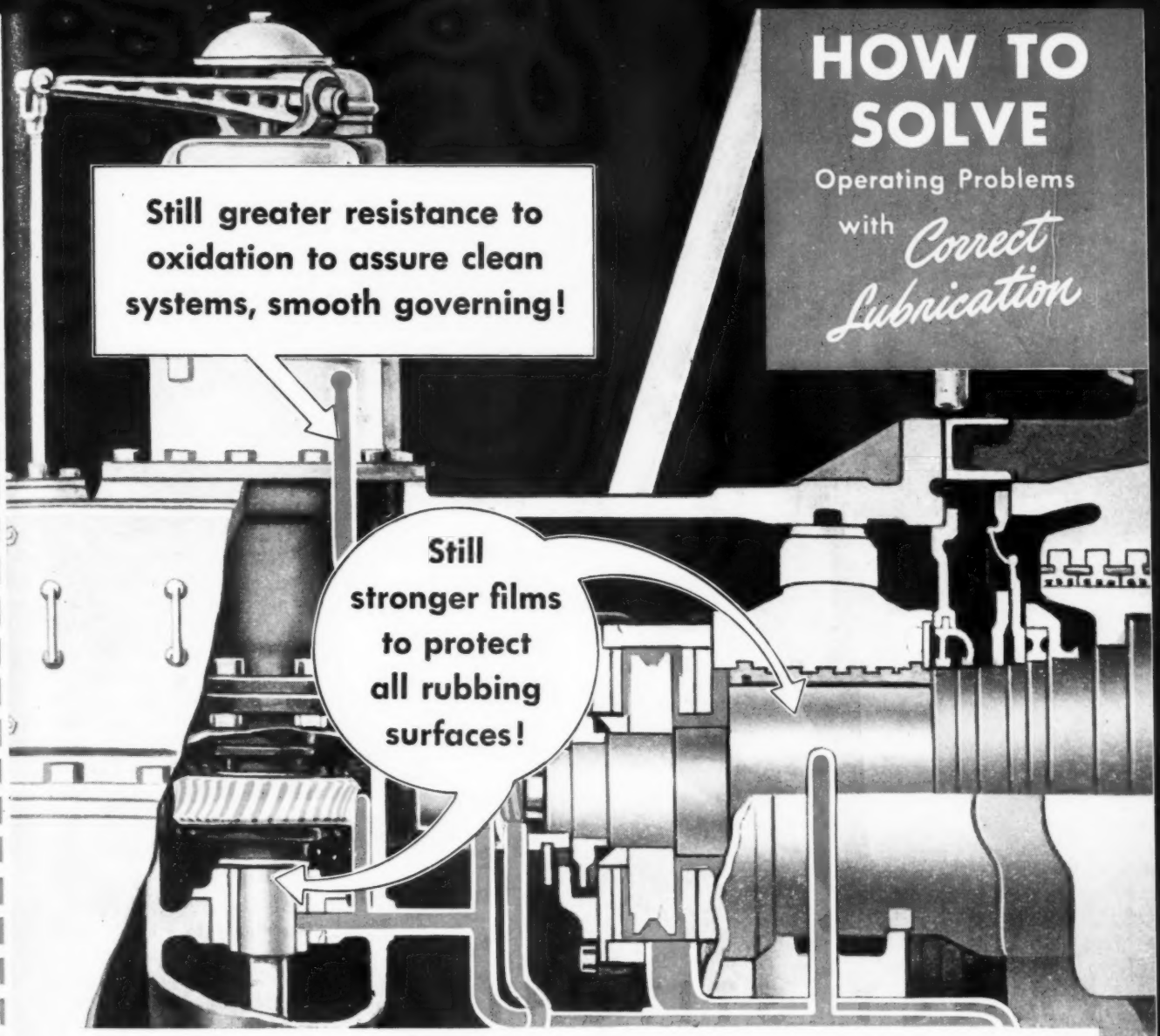
A—Cut off the bolt heads. Drill a

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

HOW TO SOLVE

Operating Problems with *Correct Lubrication*


Still greater resistance to oxidation to assure clean systems, smooth governing!
Still stronger films to protect all rubbing surfaces!

Meet severe turbine operation with this *Extra Protection!*

UNDER today's severe operating conditions, steam turbines have become more dependent than ever upon Correct Lubrication.

The oil, serving as both a hydraulic medium for the governing system and a lubricant for swiftly moving parts, faces much higher temperatures and pressures. Yet it must stand up over years of service.

Gargoyle D.T.E. Oils for Turbines have been improved to meet the most severe conditions — to provide extra margins of protection against them. They combine greater resistance to oxidation and rust with stronger films —to set even higher standards of performance than the famous D.T.E. Oils of the past.

No wonder over 50 percent of all major-size steam turbines in the United States are lubricated by Gargoyle D.T.E. Oils.

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GARGOYLE D.T.E. OILS

FANCY STITCHING
with Flame and Steel

This rather oddly designed 1000 lbs. of carbon moly fabrication was brought into actuality by the skill and experience of the men in Associated's shops. Their thorough knowledge and utilization of all advanced welding procedures, and the application of modern, pre-heating, stress-relieving equipment is indicated in work of such intricate pattern. One of many and varied fabrications now in process at Associated for critical war projects, this particular job is for use in a high octane plant . . . *The more difficult the job the more reason for calling in Associated.*

ASSOCIATED PIPING & ENGINEERING CO., INC.
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hole in each end slightly deeper than the thickness of the plate, using a drill that leaves only a thin shell of metal in the sheet. Close in this metal shell with a round-nosed chisel, taking care not to damage the threads in the plate. The piece of staybolt in the boiler then drops down into the waterleg, and can be fished out through a handhole.

If the threads have not been damaged, put in a staybolt of the same size as the old one, but if the threads are spoiled it may be necessary to run an oversized tap through the holes and put in a larger diameter staybolt. In either case, the new bolt is screwed in, cut off on each end, leaving a few threads for riveting, and riveted on each end to form a head. When one end is being riveted, a heavy hammer is held against the other end. It is important that the new bolt be a tight fit in the threads. If it is loose to begin with, it will leak in a short time and the threads may possibly corrode in the plate.

A skilful welder can burn out the center of an old staybolt with a torch in much less time than it takes to drill it out, but he must exercise great care not to burn or melt the plate. Drilling, though slower, is probably safer.

Q 12—When a hand ratchet is used for drilling holes, how is it set up?

A—If there is a convenient place for fastening it to a bolt or stud, a boring post is set up, as in Fig. 4. The base is bolted rigidly to the job and the adjustable arm clamped at the right height for the ratchet. The drill is fed into the work by the feed screw on the opposite end of the ratchet. If a boring post cannot be set up in this fashion, place some heavy object against the drill to hold it, or set up and brace a plank from an adjacent wall or other boiler or machine. To apply pressure to the drill, use the same methods as for electric or air-driven drills.

Q 13—How are watertubes fastened in tube sheets and headers?

A—Watertubes are secured the same as firetubes by expanding the ends with a tube expander. But the projecting ends are usually left untouched or simply splayed out a little without being beaded except when tubes enter the bottom of a drum. Ends of these tubes may be beaded to offer as little obstruction as possible to flow of water into the tubes, and to drain the drum completely when the boiler is emptied for cleaning, inspection or repair.

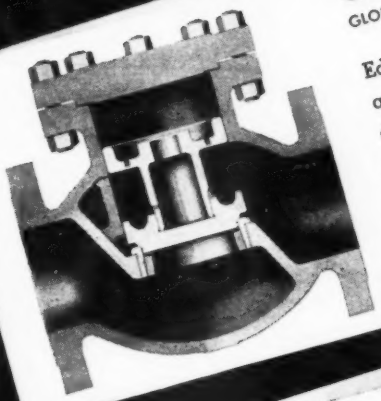
Q 14—How are defective watertubes removed and replaced?

A—Ends are split with a narrow chisel, then bent inward with a crimp-

Edward CHECK VALVES

CAST STEEL LIFT CHECKS

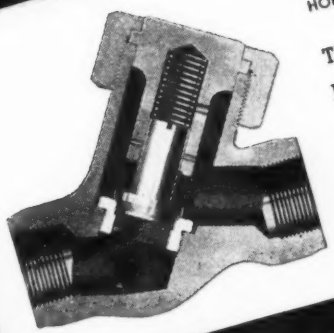
GLOBE AND ANGLE, 2½" to 14" 150 LB TO 2500 LB SP



Edward piston type check valves cut shock, slam and clatter to the barest minimum through exclusive design features that cushion disk action yet give fast, sure closure. Hour-glass disk-piston assembly moves in mirror smooth body-piston chamber, fully guided by three streamlined guide ribs integrally cast with body. Full area body gives maximum freedom of flow. Flanged or welding ends.

FORGED STEEL PISTON CHECKS

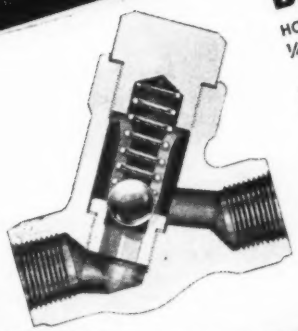
HORIZONTAL OR VERTICAL, ¼" TO 2" 150 LB TO 2500 LB SP



The same freedom from damaging shock that characterizes Edward cast steel check valves is a feature of Edward forged steel piston type check valves. Spring loaded in sizes under 1½ in. for tight, sure seating. Internal parts are designed for full flow area and cushioned closing action. Flanged or welding ends.

BALL CHECKS

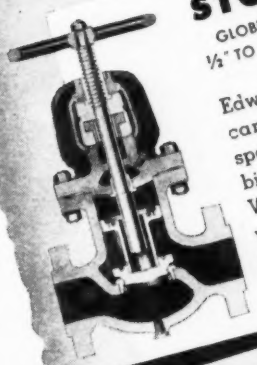
HORIZONTAL, VERTICAL & ANGLE
¼" TO 2" 150 LB TO 6000 LB



For viscous fluids or hydraulic service, Edward ball checks are ideal. The stainless steel ball, carefully mated to EValloy stainless steel seat is guided by two integral steel ribs. A spring aids seating.

STOP-CHECKS

GLOBE, ANGLE AND SEPARATED
½" TO 8" 150 LB TO 2500 LB SP

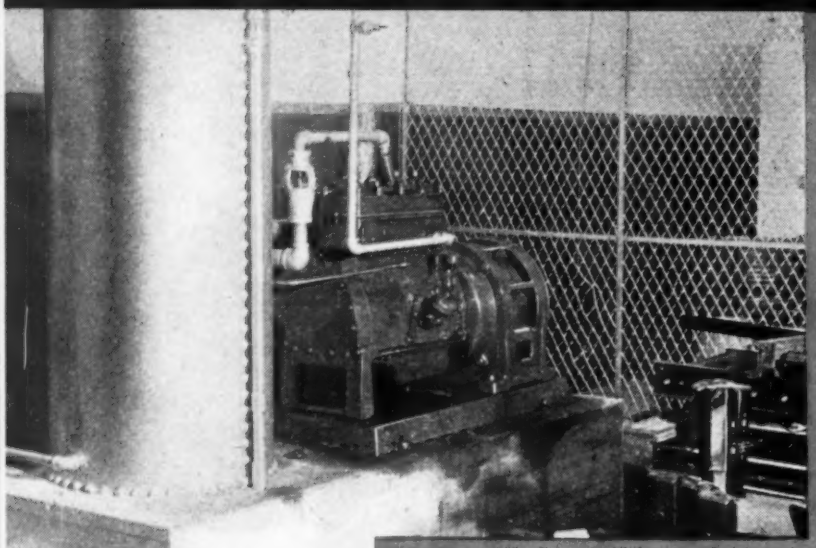


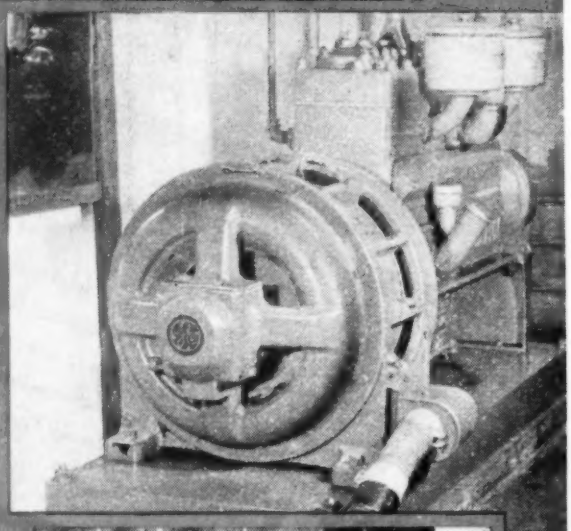
Edward stop-check valves can be used where cost or space limitations make combination valves desirable. Widely used for feedline service. Available with handwheel, gear or motor operation.

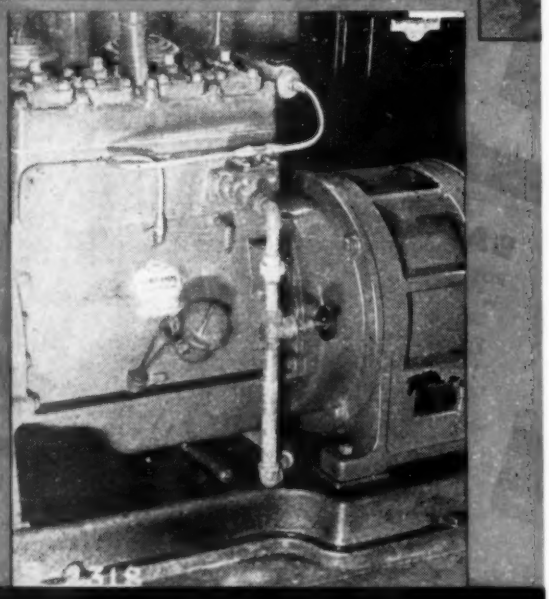
THE EDWARD VALVE & MFG. CO., INC.
East Chicago, Indiana

EDWARD *Steel* VALVES

Schramm Air Compressors







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Schramm advantages: easily bolted directly to any substantial floor . . . compact to reduce headroom and floor space requirements . . . 100% water cooled to provide top efficiency both winter and summer.

Write today for illustrated Bulletin 42-S.

SCHRAMM INC

THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

ing tool which is a short bar with a narrow slot in the end that fits over the tube. Straight tubes may then be pulled out through one of the tube holes. This is not always possible with bent tubes, whose ends may have to be worked out of each tube hole in turn and the body of the tube removed sideways. If the defective tube in a bent-tube boiler is in an inner row, it may be necessary to remove several tubes to get at the damaged one. This may require replacing almost an entire row instead of only one tube unless the spacing permits removal of a single tube.

Boiler Stresses

(*Continued from page* 93)

Cancelling out the L's we get the formula stress along a longitudinal section, sometimes called the "hoop" stress:

$$P = \frac{2 \times t \times TS}{D}$$

When we come to the end stress, we can visualize the forces a little easier. On each sq in. of the head we have a certain steam pressure acting to push the head out and the total force will be equal to the area of the head in sq in. times the pressure in lb per sq in. We know the area of a circle is equal to π times the diameter squared, divided by 4, so the force is:

$$\frac{\pi}{4} \times D \times D \times P$$

Considering again a seamless drum, we can see that the resistance to the tendency to push the head off comes from the "ring" of metal where the head joins the shell. The area of this metal is the circumference of the shell times the thickness, and the resisting strength is the area times the unit tensile strength of the material. We can write this:

$$\pi \times D \times t \times TS$$

As before, the pulling-apart force and the resisting strength must be equal, so:

$$\frac{\pi}{4} \times D \times D \times P = \pi \times D \times t \times TS$$

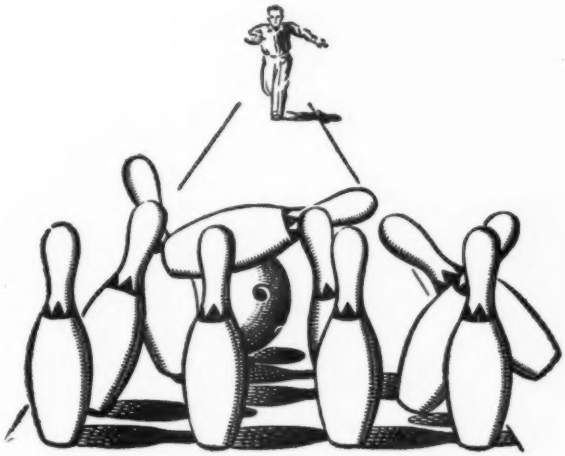
Again, we want to find the maximum safe steam pressure, so we re-arrange to get P off by itself:

$$P = \frac{\pi \times D \times t \times TS}{\frac{\pi}{4} \times D \times D}$$

Cancelling out π and D, we get:

$$P = \frac{4 \times t \times TS}{D}$$

Comparing this with the formula for

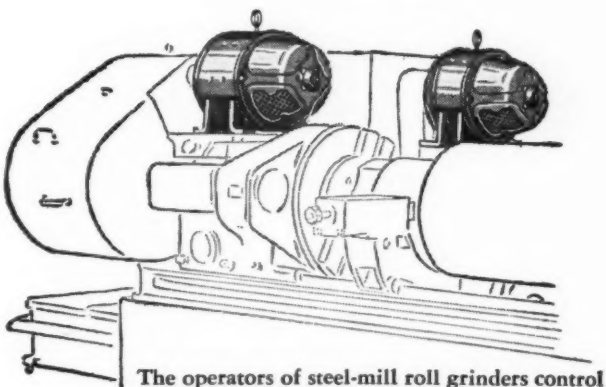


CONTROL!

Electric motor-drive, properly applied, can be used not only to supply power but to *control* a wide variety of production operations—*electrically* rather than mechanically. The results, in improved speed and quality of work, simplified design and reduced costs are frequently remarkable.

This control is accomplished through characteristics that are inherent in Reliance Electric Motor-Drive. Starting, acceleration and speed changes are simply and effectively controlled, automatic reversal can be provided at any desired point in a cycle of operations, tension can be properly and constantly maintained in the processing of such materials as metals, paper and cloth.

The "know how" which enables Reliance men to offer constructive help in working out improvements in machine design or production processes comes from applying electric motor-drive in many ways in many industries. It will pay you to take advantage of their experience.



The operators of steel-mill roll grinders control completely from a central point all functions of their huge machines, many of which are powered by as many as 9 Reliance Motors.

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RELIANCE ELECTRIC & ENGINEERING CO.

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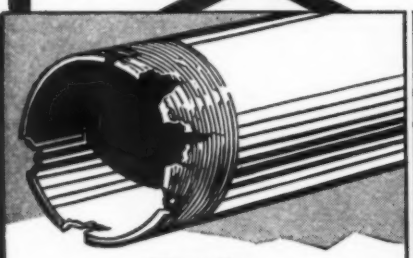
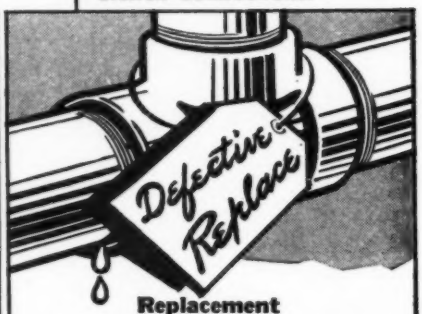
ThredOlets for screwed branch connections.

Socket-End WeldOlets for socket-type branch connections.



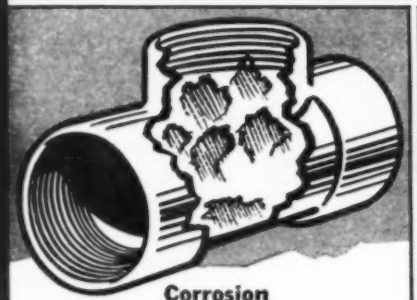
Threading

Threading weakens pipe walls as much as 40% — causes piping failures. WeldOlets, ThredOlets, eliminate threading of main pipe — make junction of full pipe strength.



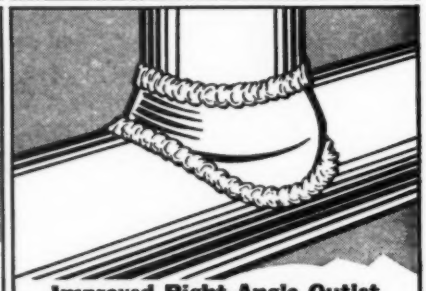
Replacement

WeldOlets, ThredOlets practically eliminate fitting replacement. Properly installed they provide trouble-free, leakproof junctions.



Corrosion

Because drop forging improves metal structure of WeldOlets, ThredOlets, they resist corrosion better than ordinary types of fittings.



Improved Right-Angle Outlet

WeldOlets, ThredOlets provide leakproof, right-angle branch pipe outlets of full pipe strength; improve flow conditions; eliminate worn threads; bolt tightening; reduce need for fitting replacement; corrosion.

WeldOlets, ThredOlets and Socket-End WeldOlets are suitable for all commonly used pressures and temperatures in every type of piping system. They are installed either before or after erection of the main line and always with ease and economy. They are equally well adapted to prefabricated or "on-the-job" assemblies. Their patented, funnel-shaped intake aperture improves flow conditions, reduces turbulence and friction.

Carried in stock for all standard pipe sizes up to 12" in size-to-size and reducing sizes—up to 24" on special order. Stock fittings are drop forged steel, but to meet unusual conditions can be supplied in Monel, Everdur, Toncan Iron, wrought iron, etc.

Bulletin WT31 gives detailed information about all the advantages of WeldOlets, ThredOlets and Socket-End WeldOlets. Write for a copy today.

Forged Fittings Division

Bonney Forge & Tool Works, Allentown, Pa.

WELDOLETS · THREDOLETS

TRADE MARKS - REG. U.S. PAT. OFF.

Welded Outlets for Every Piping System

hoop stresses we see that for the same drum dimensions, the working pressure as fixed by the hoop stress is only half that fixed by the end stress. Put another way, the hoop stress is twice the end stress, for the same internal pressure.

In all these formulas, we have used *TS* as the tensile strength of the material, which represents, roughly speaking, the maximum load it will take without failing. Because it is impossible to measure this "ultimate strength" accurately for each piece of material involved, because it is only approximately uniform for materials of the same kind, and because other factors such as temperature, vibration, etc, affect the strength, it is customary to use a much lower value, called the "allowable strength" or "working strength." This is only a fraction of the ultimate strength, usually one-quarter or one-fifth of it. Dividing the ultimate strength by the allowable strength gives a figure called the "factor of safety." This is usually 4 or 5.

Readers' Problems

(*Continued from page* 112)

if all run at equal rating, pressure differential is greatest at the point of supply nearest the dye house.

An approximate way to determine which boiler is priming would be to close one boiler's stop valve partially while the others remain open; by testing each in turn, locate the most troublesome one.

Re-locating the steam line as suggested would help to reduce the carryover. In addition, install a large trap near the dye house. It is also important to maintain the water at a constant level in all boilers because erratic feed certainly increases the trouble.

Kearney, N. J. GEORGE MCNALLY

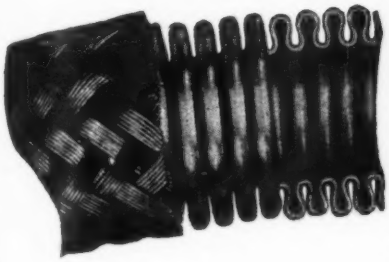
Oil-Fired Boiler Responds More Readily

CAUSE of BTF's heavy carryover is indicated by high concentration in the 175-hp boiler and comparatively low concentration in the two smaller ones. This great difference shows that the large boiler is evaporating four times as much water as the two smaller ones, and thereby carrying far more than its share of the load. At peak load, if not at all other times, the large boiler is forced to the point of surging and foaming with resulting carryover, while the

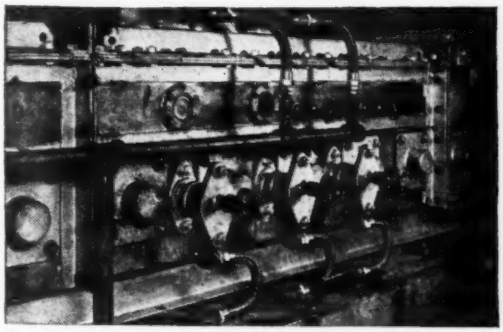
"Flexible as rope
STRONG AS PIPE
Essential in hundreds of services"

That might be one way to sum up American Metal Hose... the all metal conductor that conveys gases, oil, steam, water, air, solvents, chips and dust under the widest range of temperatures, pressures and exposures to be encountered in industry... the flexible tubing that isolates vibration, connects misaligned parts, loads and discharges cargoes... provides rigid pipe security in connecting moving machine parts with gas, oil, air, water, or steam supply.

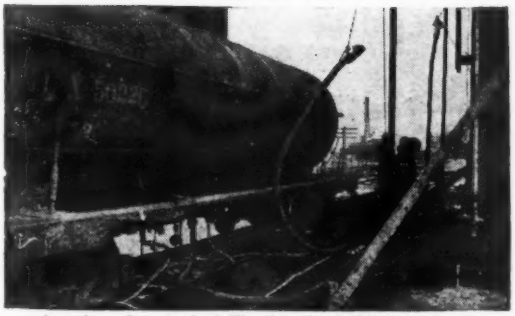
AMERICAN SEAMLESS



American Seamless. For applications where 100% tightness is essential. Made from *seamless* metal tubes — no packing, joints, welds or laps — the best "insurance" against leakage. Ideal for conveying air, oil, steam, water, volatile liquids and gases. Wire braid "jackets" reinforce tubing for high pressure services. Available in any workable metal.



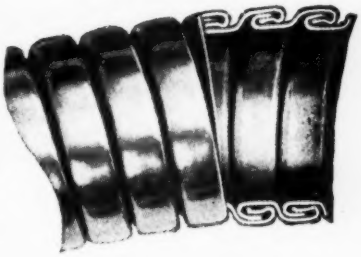
American Seamless Flexible Bronze Tubing insures tight, free-flowing water connections to safeguard the accurate, continuous performance of this shell-case annealing furnace.



American Interlocked Flexible Steel Oil hose loads and discharges tank cars, may be used on practically any cargo that will flow through a pipe.

AMERICAN INTERLOCKED

American Interlocked. Strip metal, wound into "full-interlock", packed with asbestos, forms the toughest flexible hose for all-round service... the strength and last-ability of metal plus extreme flexibility for ease in handling. Made in bronze for steam and water — galvanized steel for oils...also in other workable metals.



AMERICAN TYPE U.I.

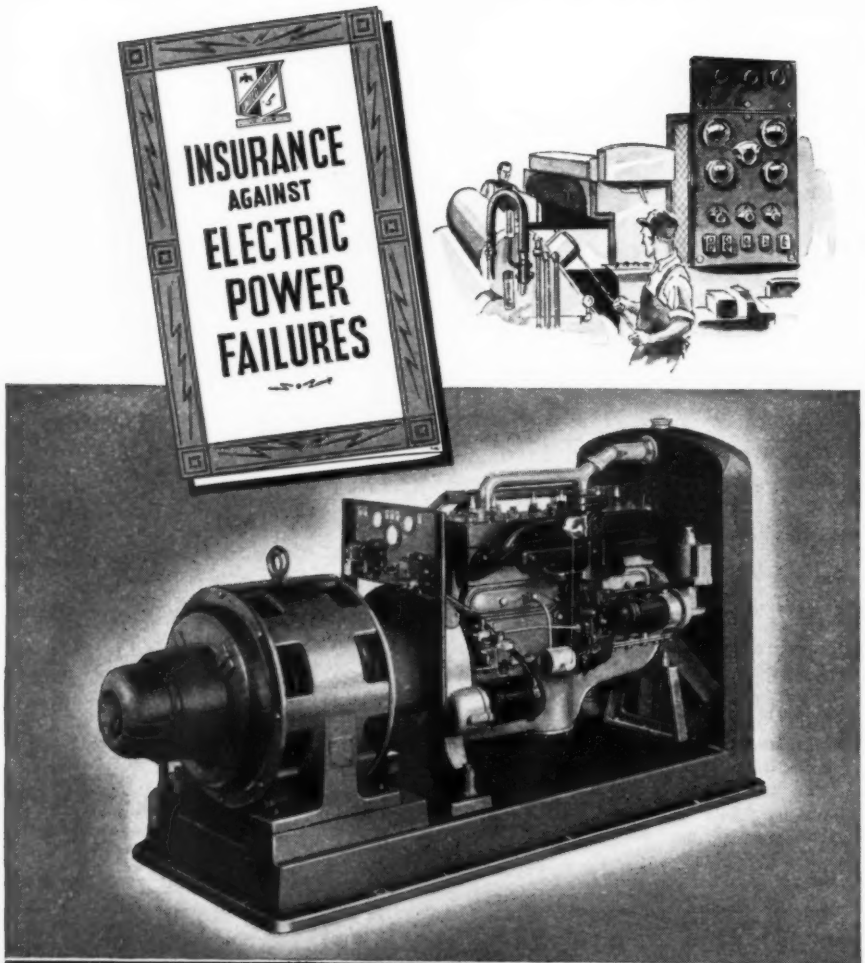
American Type U.I. Full interlocked, but unpacked... a lightweight flexible metal hose for carrying hot air, grinder dust, chips or light dry material. Made from brass, galvanized, stainless steel, aluminum, in sizes to 8" I.D. 44193

American Flexible Metal Hose, Type U.I., fights the boll weevil in conveying chemical powder to the spray heads on this Cotton Dusting Machine.

ANACONDA
from mine to consumer

American Metal Hose

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY • General Offices: Waterbury 88, Conn.
Subsidiary of Anaconda Copper Mining Company • In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ontario*



SAFEGUARD CRUCIAL PROCESSES WITH

EMERGENCY STAND-BY SERVICE

Hospitals, mines, electric furnaces, oil refineries, crucial, non-stop manufacturing processes dependent upon electrical energy — you can be safeguarded against serious loss and damage with a U. S. Emergency Stand-by unit. There's deep satisfaction in knowing that a dependable emergency plant stands by at all times, ready to take over instantly in case your regular source of electricity should fail. Write for details today. U. S. Electric Plants, Diesel or Gasoline up to 75 KW, can be supplied now on AA3 priority or better where production does not interfere with Army-Navy requirements.

UNITED STATES MOTORS CORP. - OSHKOSH, WIS.

U.S. Electric Plants

FOR EMERGENCY STAND-BY SERVICE

smaller boilers almost idle on the line.

Being farthest from the point of greatest demand does not keep the large boiler from supplying more than its share of steam. Changing the smaller boilers from oil to stoker firing probably aggravated this condition inasmuch as an oil-fired boiler usually responds more readily to heavy jerk loads.

Since there are no meters and the load must be distributed by guess, remedy may not be easy. Blowing down the larger boiler more frequently may help. But the obvious remedy is to install individual indicating-recording flowmeters on each boiler, then distribute the load between the three boilers, especially at peaks.

Marissa, Ill. GEORGE HOLMAN

Install Calorimeters

FROM BTF'S STATEMENTS there seem to be three reasons why No. 1 boiler is the chief offender with respect to carryover. Steam velocity leaving the boiler is more than twice that of the other two when operating at the same percent rating.

Amount of carryover, method of measurement, and the resulting economic loss are not stated. Hence it is not known what expenditure is warranted in overcoming the difficulty. I suggest the following procedure:

1. Install purchased or homemade throttling calorimeters on each boiler outlet and follow the *ASME Power Test Code* dealing with moisture determinations.

2. Adjust blowdown to steam output to obtain equal total solids values in all boilers.

3. Make a complete boiler-water analysis, checking for oil or organic content which if present even in small amounts could affect priming.

4. Check returns carefully for any contamination shown by analysis until source is located.

5. Measure fuel or feedwater and estimate steam output to compare with calorimeter readings and determine boiler rating which gives undesirable carryover.

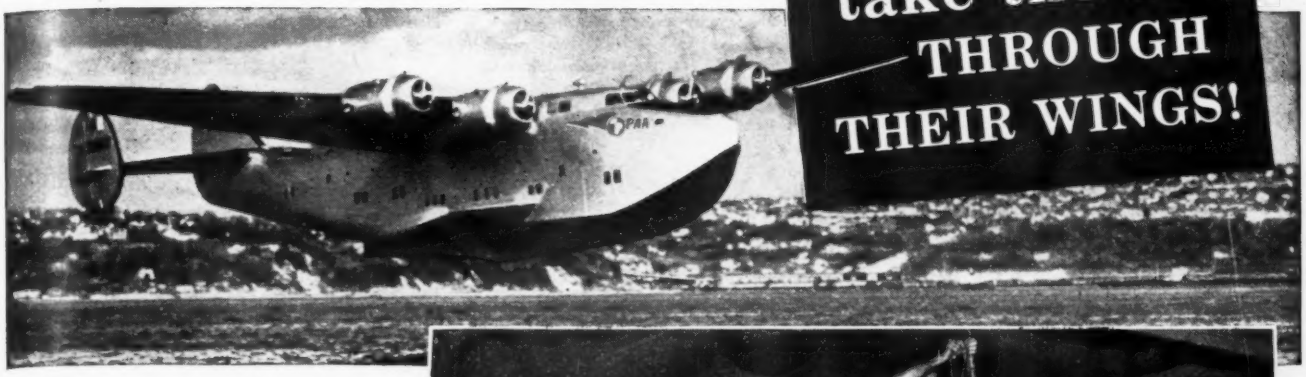
If this procedure does not reveal the cause of trouble, or if existing conditions cannot be altered, the problem becomes one of moisture removal between boilers and equipment using steam. Steam separators properly installed and drained should produce satisfactory moisture content. It is much more desirable, however, to find and remove the cause.

Saint John, N. B. C G CLARK

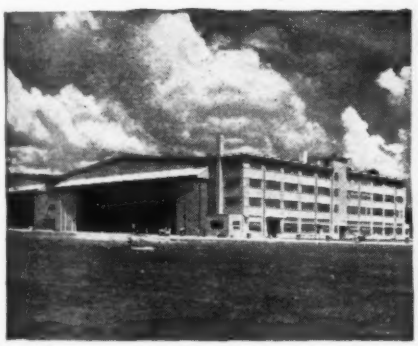
(*Continued on page* 150)

Pan Am Clippers

take the air THROUGH THEIR WINGS!



HOW would *you* like working inside the wing of a plane where air seems to be rationed by the cubic inch? Ever fit an ornery part there while the sweat runs into your eyes and off the end of your nose? If you haven't — try it sometime — you'll understand why 100% efficiency is utterly impossible under such conditions.



Coppus Ventilator furnishing fresh air to wing compartment

This problem has been solved by Pan American World Airways at its new million-dollar Miami hangar, one of the largest in the world. Here Coppus Ventilators supply fresh air to employees working in confined compartments, fuselages and wings. These same Coppus Ventilators are used for field service, too.

Pan American is one of many leading airlines using portable Coppus Blowers and Exhausters to step up production wherever bad air or heat threatens health and efficiency. And Coppus Blowers are used even to inflate barrage balloons for testing seams.

At low cost, you, too, can bring to workers a continued supply of invigorating cool air. The "Blue Ribbon" (a blue band) is your assurance of quality performance at lowest cost. Send for specific information on Coppus Blowers and Exhausters for cable manholes, tanks, shipholds and general man-cooling. Use the coupon.

MAIL COUPON To Coppus Engineering Corp., 513 Park Ave., Worcester 2, Mass.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

A COPPUS
"BLUE RIBBON" PRODUCT

DESIGNED FOR YOUR INDUSTRY ...ENGINEERED FOR YOU

- ☐ in aeroplane fuselages, wings, etc.
- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ on boiler repair jobs.

Other Applications:

- ☐ general man-cooling.
- ☐ cooling motors, generators, switchboards.
- ☐ exhausting welding fumes.
- ☐ freshening air where men are working or material is drying.

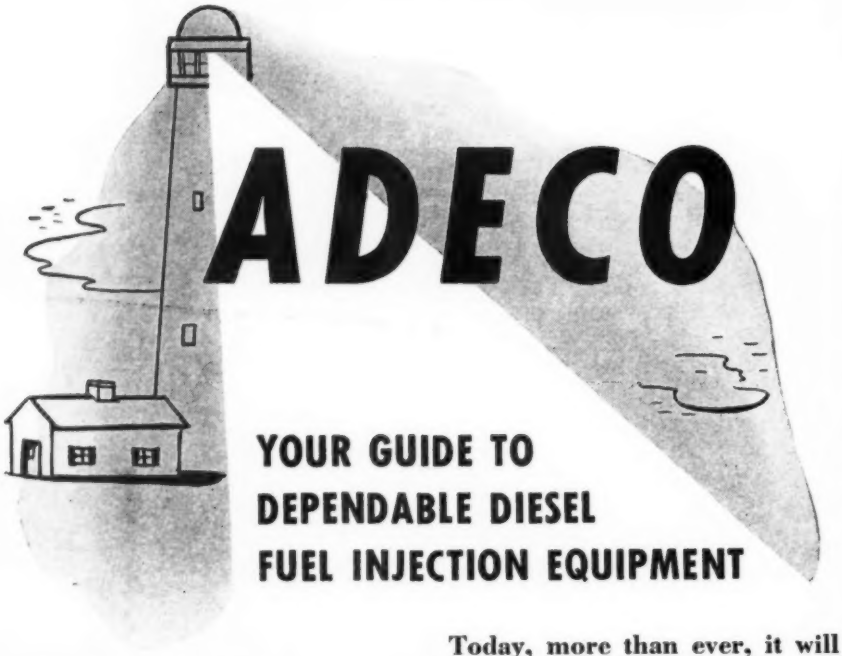
NAME.....

COMPANY.....

ADDRESS.....

CITY.....

Write here any special ventilating problem you may have.....



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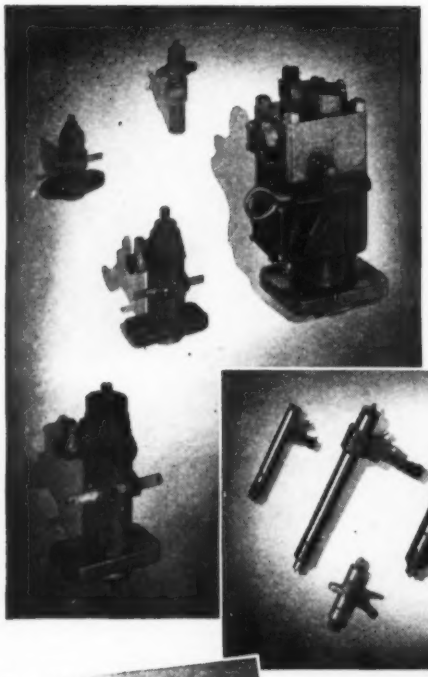
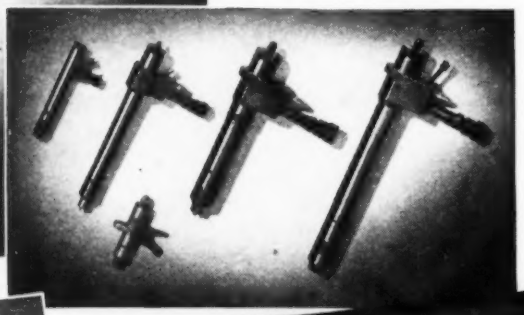
YOUR GUIDE TO DEPENDABLE DIESEL FUEL INJECTION EQUIPMENT

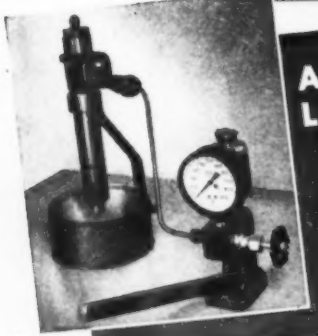
Today, more than ever, it will pay you to look to Adeco as your guide to dependable fuel injection equipment.

Every Adeco fuel injection pump, nozzle and nozzle holder reflects the long experience in precision design and workmanship gained through years of pioneering and research for the diesel industry.

There's a wide range of standard equipment to meet your most exacting needs.







ADECO NOZZLE TESTER FOR LOW-COST MAINTENANCE

America's most widely used Nozzle Tester enables any mechanic to make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Compact, portable, sturdy, precision-built. Pressure up to 10,000 p.s.i. Tests both large and small injectors. Avoids costly delays and possible damage to engine. Also obtainable with Navy-approved gauge. Write for new bulletin.

Ideal for Testing Hydraulic Equipment

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AIRCRAFT & DIESEL EQUIPMENT CORPORATION
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CHICAGO 40, ILLINOIS

Answers to Jan. Question 2

(*Continued from page* 113)

very highly and round off the other edges of the holes, leaving a streamlined surface which offers minimum resistance to water flow.

This, of course, would unbalance the rotor still further, but it can be easily rebalanced. All that is required is a pair of parallel iron bars, a pair of supports and a spirit level, as in sketch 2-C. If parallel bars are not available, try two short pieces of shafting that are parallel and smooth.

Mount them on a pair of supports and level them in both directions. Lay the pump shaft and impeller across them and roll carefully by hand, noting position in which the rotor stops. Make a chalk mark on the bottom side of rotor. Now, stick just enough clay or putty on the opposite side of the rotor so that it balances and rolls even, without stopping in any particular spot.

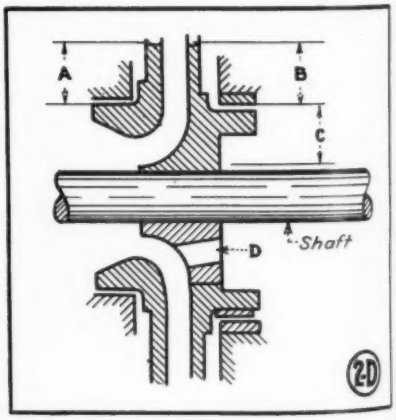
By removing and weighing the clay, you can find the exact weight of metal to be cut from the point directly opposite, which is the location of the chalk mark.

Next, use a good sharp chisel and remove this weight of metal by cutting a groove, leaving edges rounded and contour streamlined. This is preferable to brazing or adding to the impeller any material which may eventually become loose and cause trouble.

Kearney, N. J. GEORGE MCNALLY

Holes Were Not Drilled for Balancing

THE ANSWER to BJM's first question is *no*. The holes were not originally drilled to balance the impeller since balancing is done as in sketch 2-D.



Operating clearances are necessary for proper pump performance and since *A* and *B* dimensions are the same and fluid pressure on the impeller shrouds

(*Continued on page* 156)

DON'T HANG YOUR PRODUCTION ON A *Shoestring* PLANT POWER SYSTEM

● **POWER DISTRIBUTION SYSTEMS, like shoestrings, are generally kept in service till something *snaps*. Minor troubles are laid to other causes, and major breakdowns come too late for preventive remedy.**

Today, many otherwise well-equipped plants are "just getting by on a shoestring" when it comes to electric power supply, with make-shift circuits, hand-me-down equipment, and long, overloaded feeders.

If your power system was adapted and extended under pressure to carry loads it was never designed to meet, the chances are that it's partly or wholly inadequate—it's the overlooked cause of outages, poor lighting, sluggish drives, high power losses, extra maintenance expense, and danger to personnel. Nurse it through for the time being if you must, but plan your next move to get away from these risks and losses.

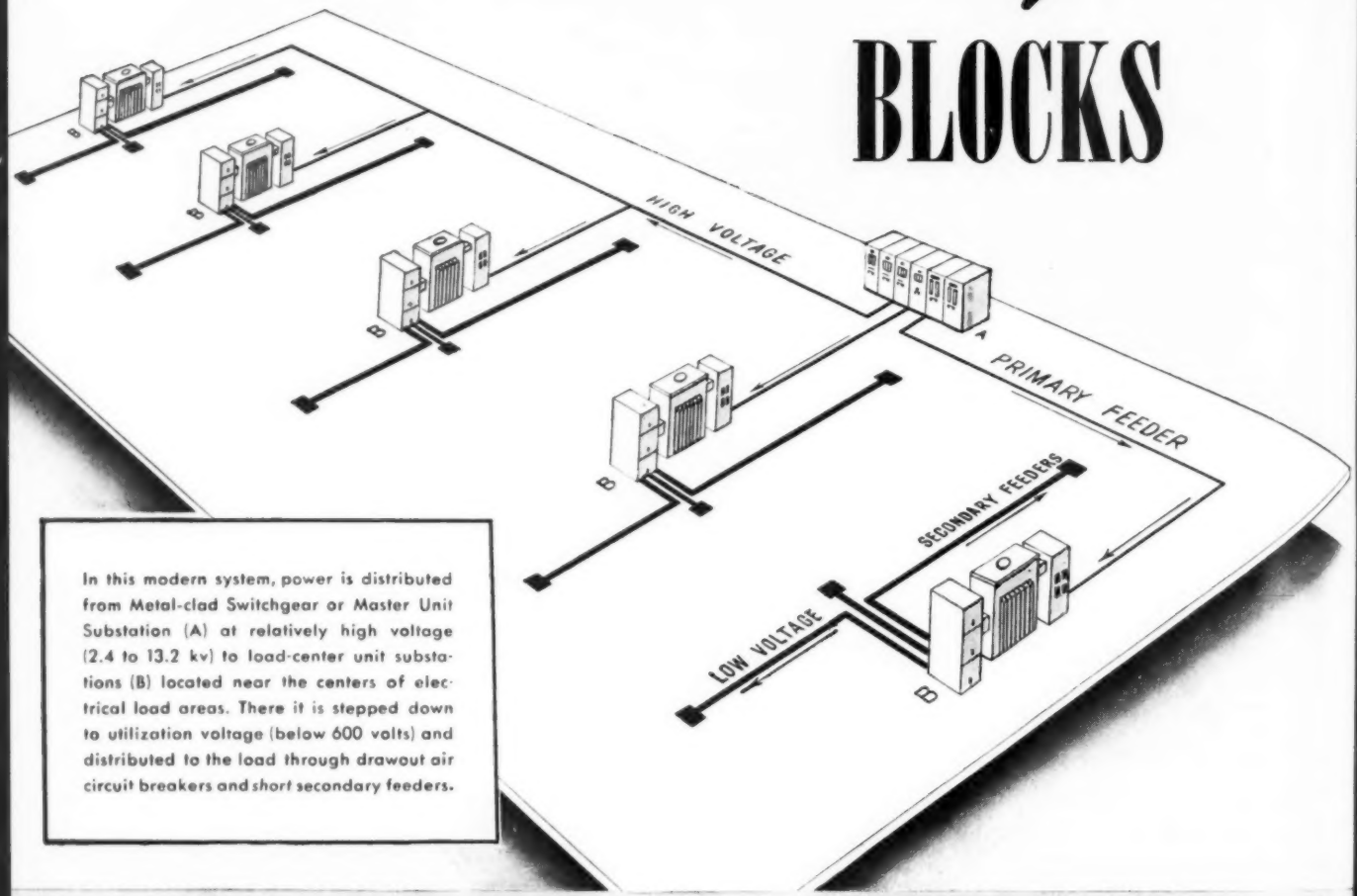
HERE'S *News* . . .

of modern power distribution—G.E.'s load-center system, which you can install as a complete system, or block by block until the complete system is assured.

GENERAL ELECTRIC

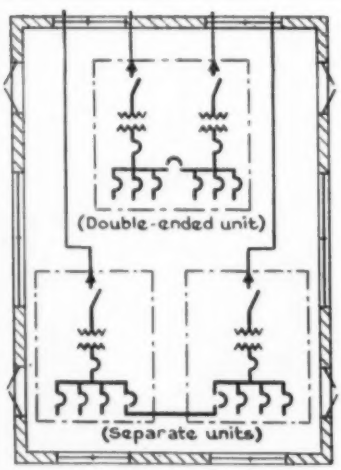
302-27-5900

Electric POWER-SUPPLY SYSTEM *based on ready-built* BLOCKS

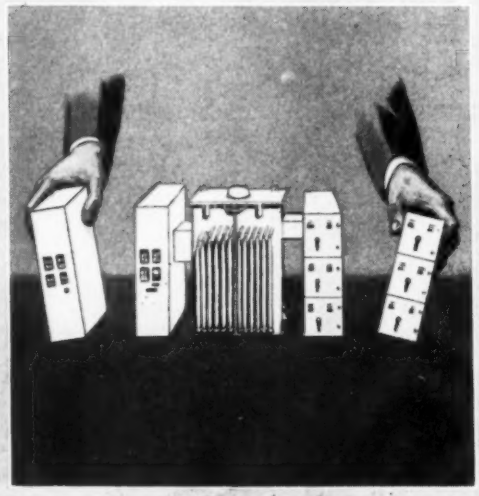


In this modern system, power is distributed from Metal-clad Switchgear or Master Unit Substation (A) at relatively high voltage (2.4 to 13.2 kv) to load-center unit substations (B) located near the centers of electrical load areas. There it is stepped down to utilization voltage (below 600 volts) and distributed to the load through drawout air circuit breakers and short secondary feeders.

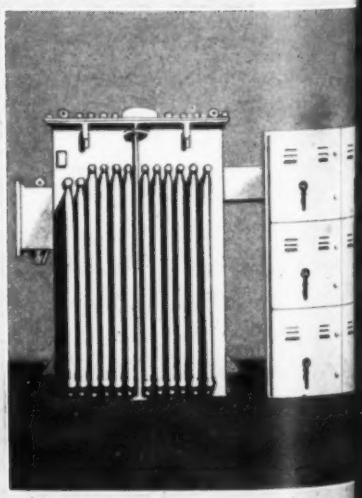
THE CIRCUIT ARRANGEMENT YOU NEED — BUILT UP FROM CO-ORDINATED UNITS — OF STANDARD DESIGNS



No system is more *flexible* than load-center distribution. Units can be combined in any one of a number of basic circuit arrangements. (Diagram shows secondary-selective hook-up.)



Like a set of blocks, the elements that go to make up a complete electric power system can be combined in many ways, without engineering or construction delays. All parts are designed to work together.



The components of a G-E unit substa are of standard design. Installation maintenance are simplified; no wo about oddities or misfits. You get ex the right assembly for the load condi

SAFEGUARDS

Your Plant from Crippling Outages

THIS MODERN SYSTEM FOR DISTRIBUTING ELECTRIC POWER protects your plant from power shutdowns in two ways: Low-voltage power is distributed from unit substations within definite load areas. Circuit protection here ISOLATES trouble, leaving all other areas unaffected.

In addition, each individual substation is unusually strong in SELF-PROTECTION features. By co-ordinated "system" arrangements, two or more sources of supply to any local circuit can easily be provided.

DELIVERS

Full Voltage to Every Lamp and Machine

LONG, CIRCUITOUS LOW-VOLTAGE FEEDERS are eliminated by the load-center system. This ends the basic cause of most low-voltage troubles, and limits costly IR-drop losses. Dim lighting and sluggish power are avoided. Each substation is matched to local load conditions within your plant, and delivers full-voltage power over short, direct feeders to motor controls, lighting panels, and the like. Wiring problems are simplified. Naturally, this method also means great savings in cable copper.

Ask for Bulletin GEA-3758A

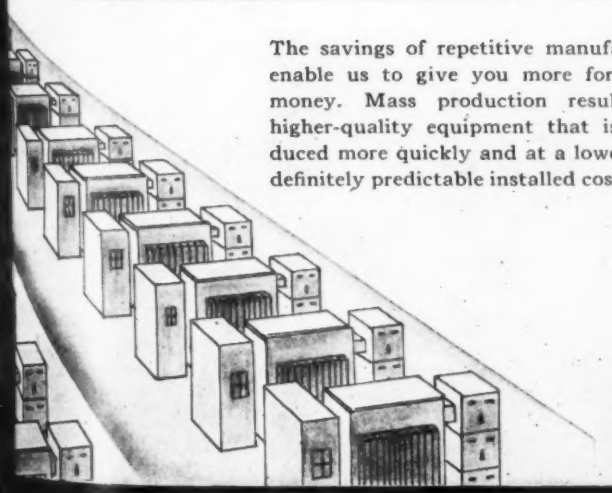
SAVES TIME

In Plant Planning and Conversion

LOAD-CENTER POWER DISTRIBUTION SYSTEMS enable your engineers to make maximum use of available standard apparatus such as unit substations and metal-clad switchgear. They can be laid out by means of a simple "one-line" diagram, fitting ready-built equipment combinations to your specific needs. This method permits placing orders months earlier, and thereby gets plants into production sooner.

If plant conversion alters power loads, substations can be quickly relocated.

EPETITIVELY MANUFACTURED



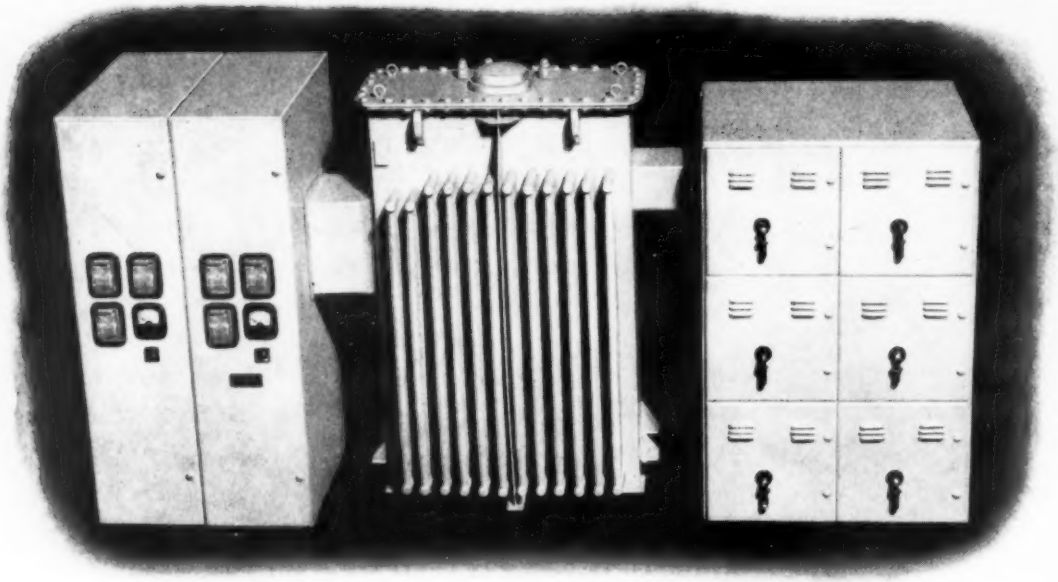
The savings of repetitive manufacture enable us to give you more for your money. Mass production results in higher-quality equipment that is produced more quickly and at a lower and definitely predictable installed cost.

LOAD-CENTER POWER DISTRIBUTION SYSTEMS

GENERAL ELECTRIC

THE G-E UNIT SUBSTATION

Is the Basic Building Block of Load-center Systems



★ **Each block is a completely co-ordinated unit, as easy to specify as a standard machine tool.**

★ **Safely "at home" anywhere in the plant because of the Pyranol transformer and metal-enclosed switchgear.**

★ **Offered in flexible combinations of incoming-line and secondary-circuit arrangements, from 200 to 2000 kva.**

Metal-clad primary protection. Each high-voltage circuit is isolated in its separate, grounded, steel compartment.

Vertical-lift breakers are easily removable for inspection. For safety's sake, you can't elevate or lower breakers unless they are open.

Drawout air circuit breakers for secondary circuits are individually metal-enclosed. Breakers are interchangeable, avoiding delays during routine maintenance. Interrupting capacities are correct for the transformer ratings.

The PYRANOL* transformer section makes vaults unnecessary for indoor installation. No Pyranol transformer has ever burned or contributed to a fire.

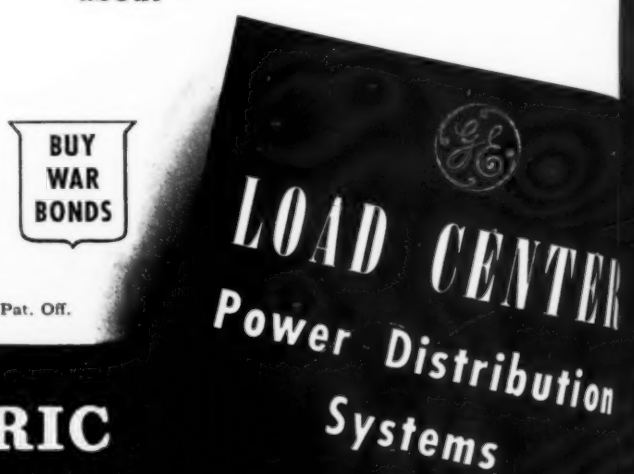
Pressure-tight tanks protect vital parts from dust, dirt, dampness. Little or no maintenance is required.

The heat-storage capacity of the core-and-coils and of the cooling liquid makes the Pyranol transformer ideal for emergency overloads.

As an integral part of a G-E unit substation, each transformer is electrically matched with its accompanying primary and secondary switchgear.

More information in Bulletin GEA-3592. *General Electric Company, Schenectady, N. Y.*

Ask your local G-E representative about—

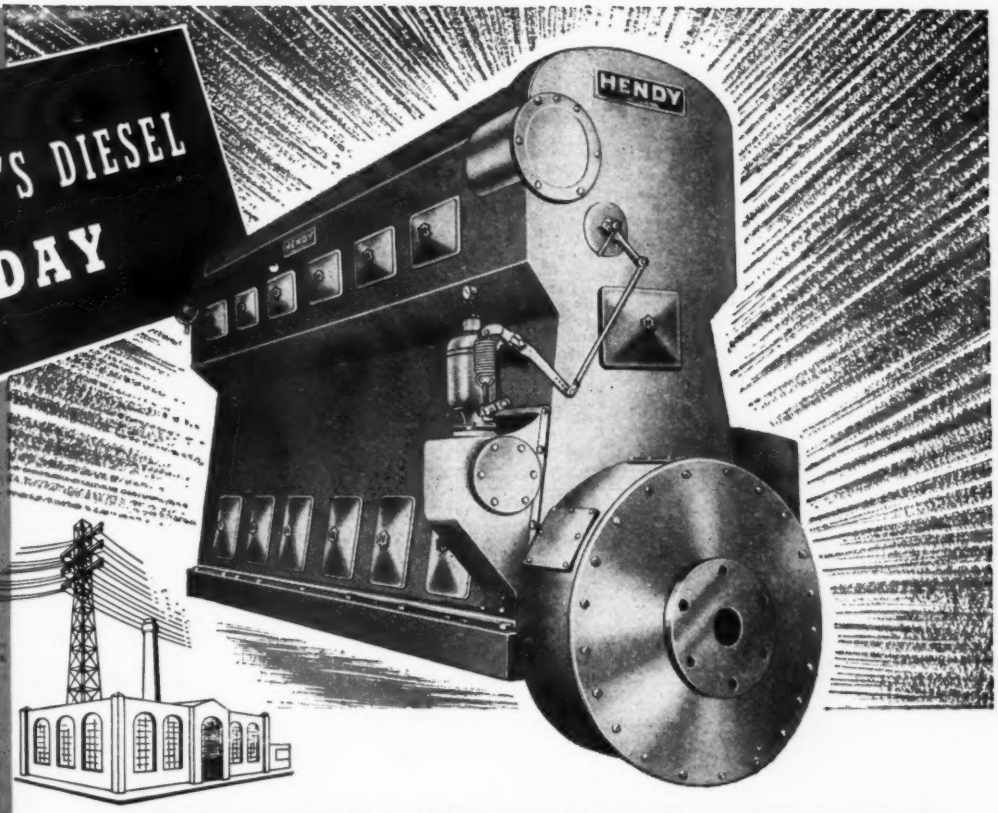


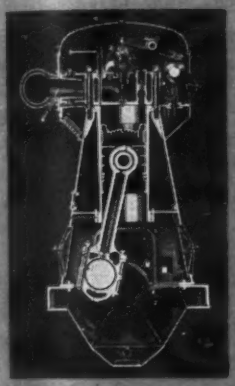
BUY WAR BONDS

*Reg. U.S. Pat. Off.

GENERAL ELECTRIC

TOMORROW'S DIESEL TODAY





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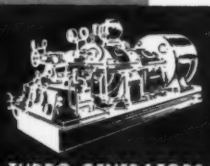
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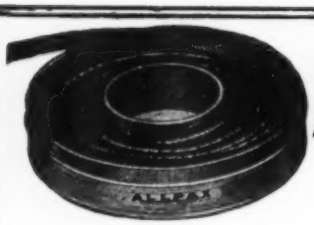

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is equal, total force acting on both shrouds must be of equal magnitude and balanced. Remaining portion of the impeller is unbalanced and since an opening must be provided for taking in liquid, the impeller is subject to suction pressure. However, back portion of impeller in the upper section is solid and subject to some reduced pressure; say 25% discharge pressure, acting at point *C*. If the back wearing ring were eliminated, unbalance or thrust would be of greater magnitude. To balance the impeller completely, balancing ports are drilled, as in lower portion at *D*. These ports then subject area *C* to approximately suction pressure and thereby balance the pressures acting on the impeller. It can then be considered in hydraulic balance.

Cavitated area as well as blind holes can be built up by brazing. The difficulty of such a job depends on impeller material and degree of curvature. I suggest a slight preheating of the area surrounding the point to be brazed; if the material is cast iron, take extreme care in preheating. If the impeller is steel, it may be advisable to weld the cavitated areas. The impeller, after being repaired, should be cleaned and dynamically or statically balanced to insure proper rotational balance, thus preventing bearing difficulties and shaft-sleeve scoring.

East Orange, N. J. R C McDONALD

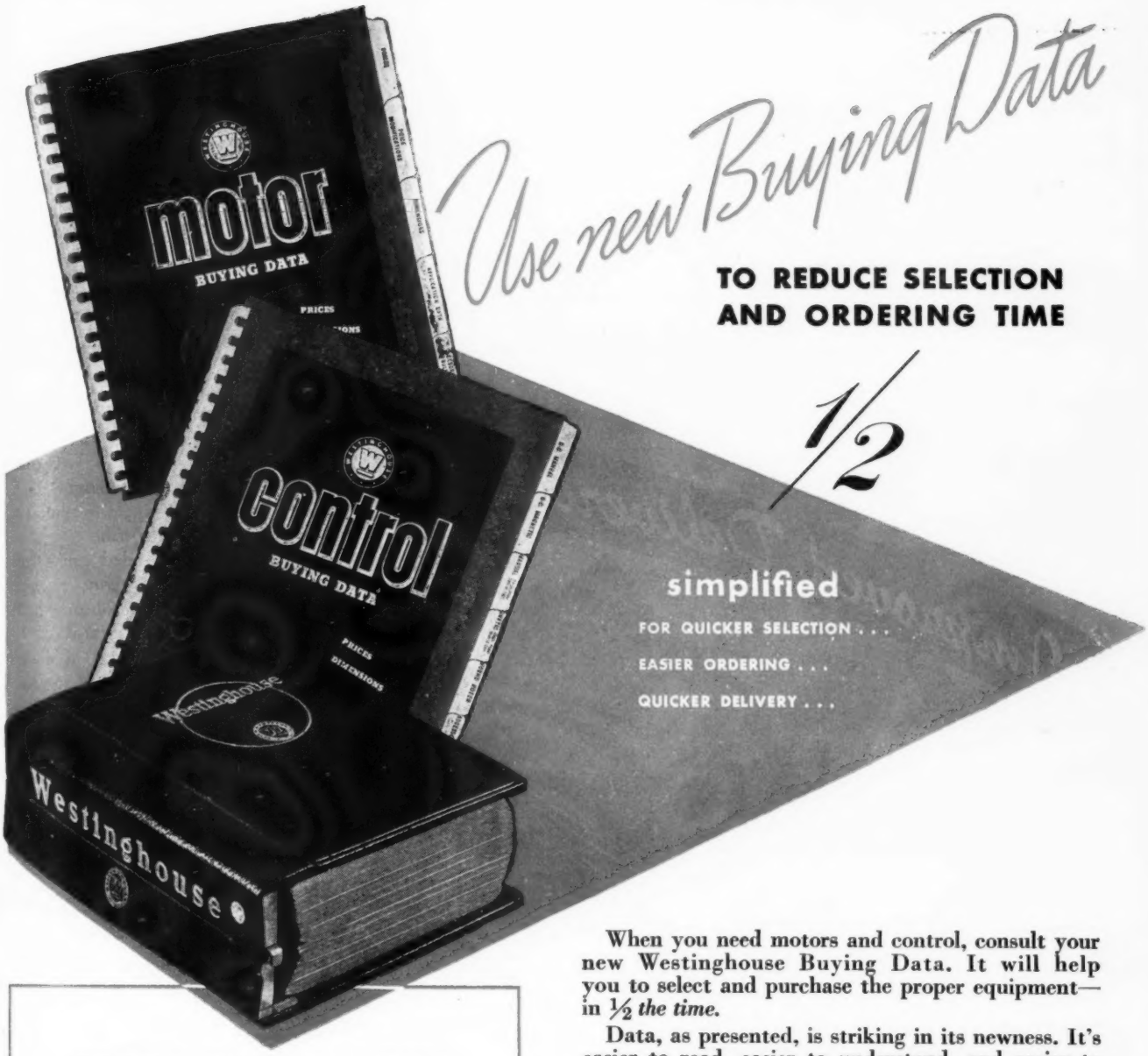
Trouble Is Caused By Erosion

THE TWO WORN SPOTS in BJM's pump quite evidently result from erosion—not cavitation. This is a phenomenon within the water itself as a result of suction head on the pump being excessive in proportion to suction developed by the pump. In other words, the pump is starved for water, and under this condition small bubbles of partial vacuum may form. In time, the striking of these bubbles upon the surfaces of the pump parts results in serious cutting.

I would expect cavitation to appear on the impeller surfaces in contact with the motion of the main water stream. Essentially the only water moving past the two worn spots is the leakage necessary to fill the space between impeller and casing to maintain a seal.

Apparently the two eroded spots result from the edges of the blind holes *hooking into* the seal water and dragging it around with the impeller. Worn condition of these holes does not necessarily indicate excessive short circuit or seal leakage.

It is most unfortunate that BJM has



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"Control Buying Data" listing a wide variety of controllers and accessories for direct current, single-phase, squirrel-cage, wound rotor motors.

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been stuck with an impeller of such quality that these two holes were necessary for running balance. They suggest the existence of some concealed sand-hole flaws somewhere about 180 deg. away. He might try prospecting with a light hammer or a small drill in the suspected vicinity of concealed flaws. If they can be located and are not too greatly dispersed they could be chipped out and the space built up, permitting filling in both the eroded spots as well as the undesirable balancing holes.

Failing in this, I would advise: (1) Turning the old impeller in as scrap and get a new one (without balancing holes), or (2) Build up eroded spots and holes, and then redrill the holes to restore balance. As long as the impeller is used with the balancing holes present, BJM can expect to repeat these repairs from time to time.

Repairs to the eroded areas can be made by brazing without preheat if normal precautions are observed. However, just this word of warning. If the impeller is bronze, and BJM does preheat it, he should be careful in supporting and not preheat it too much, or it might sag hopelessly out of shape from its own weight. I had that happen to me one time.

Tecumseh, Kan. H M NAYLOR

Engineers' Books

(*Continued from page* 122)

uses plastics. These applications include synthetic rubber in packings, conveyor and transmission belts, and insulation on electric power wires and cables; other plastics are used for gears, pulleys and sheaves, bearings, insulators and many other purposes.

Progress in plastic development and use has been so rapid since publication of this book one year ago that a second edition is now justified to bring the subject up to date. Added are 144 pages to cover the various synthetic rubbers, low-pressure laminating, trends, developments and general properties and uses for molded plastic materials. Some minor changes in the first edition bring the general data in line with today's problems. Written for users and potential users, this book gives basic information concerning plastics, their history, origin, raw material sources; physical, chemical, mechanical and electrical properties and their lamination; method of fabrication and essential information on design. It is intensely practical and easily understood by everyone interested in plastics.

(*Continued on page* 160)

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Arc Welding

MAINTENANCE ARC WELDING (1943) *Issued by The James F Lincoln Arc Welding Foundation.* 233 *pages,* 6x9 *in.,* 50 *cents in U. S.,* 75 *cents elsewhere.*

This is a practical man's book. Each of its 15 chapters is written about maintenance arc welding in a specific industry and by a responsible practical engineer in that industry. Industries covered include bakery, steel, cement, ceramic, chemical, coke-oven plant, copper plant, oil refinery, farm machines, fiber and plastics, furniture, gravel, machine tools, saw mill, iron ore.

Of specific interest to power engineers are chapters on power-generating stations and hydraulic-turbine maintenance, but the others contain much material that may be used in solving practical welding problems encountered by power engineers in industry.

BRIEF REVIEWS

INDUSTRIAL HEAT AND POWER CONSERVATION MANUAL (1943). *Published by Industrial Mineral Wool Institute,* 441 *Lexington Ave, New York* 17, *N. Y.* 20 *pages, paper bound. Available on request.* This technical and practical booklet on heat insulation details calculations for nine typical cases: boiler shell, heat-storage tank, boiler setting, drier, boiler drum, feedwater heater, duct, piping, flanged joint. Booklet shows how to figure heat and fuel losses, possible savings, time required for fuel savings to pay for insulation. Particularly useful is inserted "Heat Loss Estimate Sheet" with complete instructions to facilitate insulation survey of user's plant.

MOTOR BUYING DATA and CONTROL BUYING DATA. *Prepared by Westinghouse Elec & Mfg Co, East Pittsburgh, Pa. Available without charge from district offices only.* Bound books contain prices, dimensions, application data and descriptions. The former, 180 pages, covers popular models and ratings of motors, gearmotors and mg sets. The latter, 276 pages, loose-leaf form, on controls and accessories for motors, contains product listings, plus information on special features required for specific industries.

FEEDER VOLTAGE REGULATOR STANDARDS *(Publication 43–86, Oct, '43). Published by Natl Elec Mfgrs Assn,* 155 *E 44th St, New York City.* 28 *pages,* 8x10½ *in.,* 75¢. For the first time all the standards of a national character having to do with feeder voltage regulators and step type voltage

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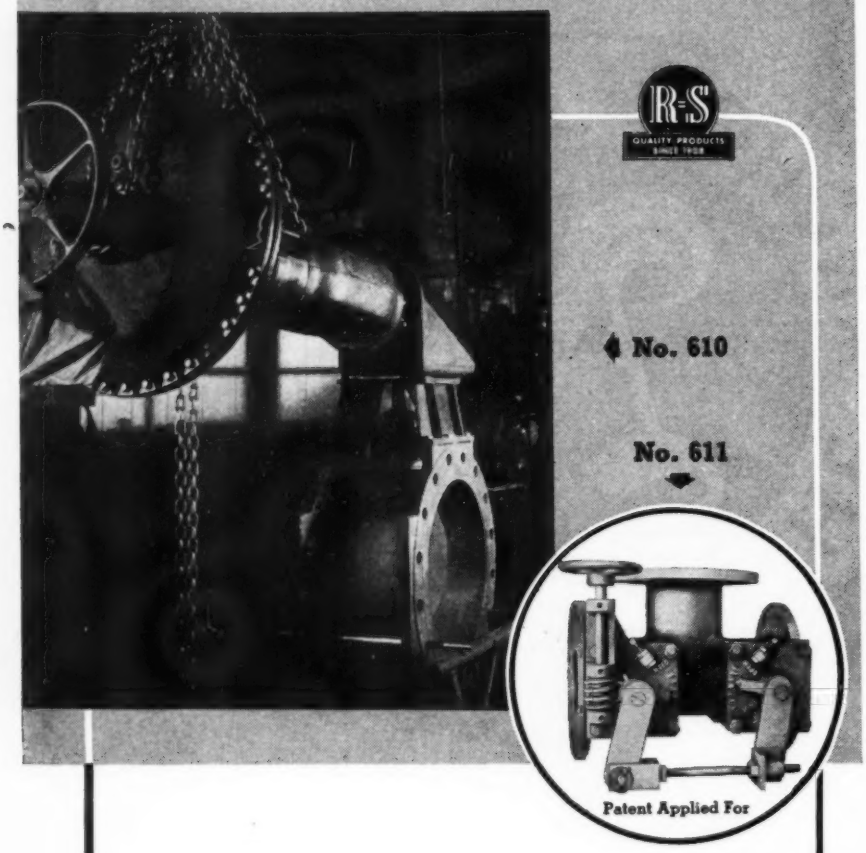

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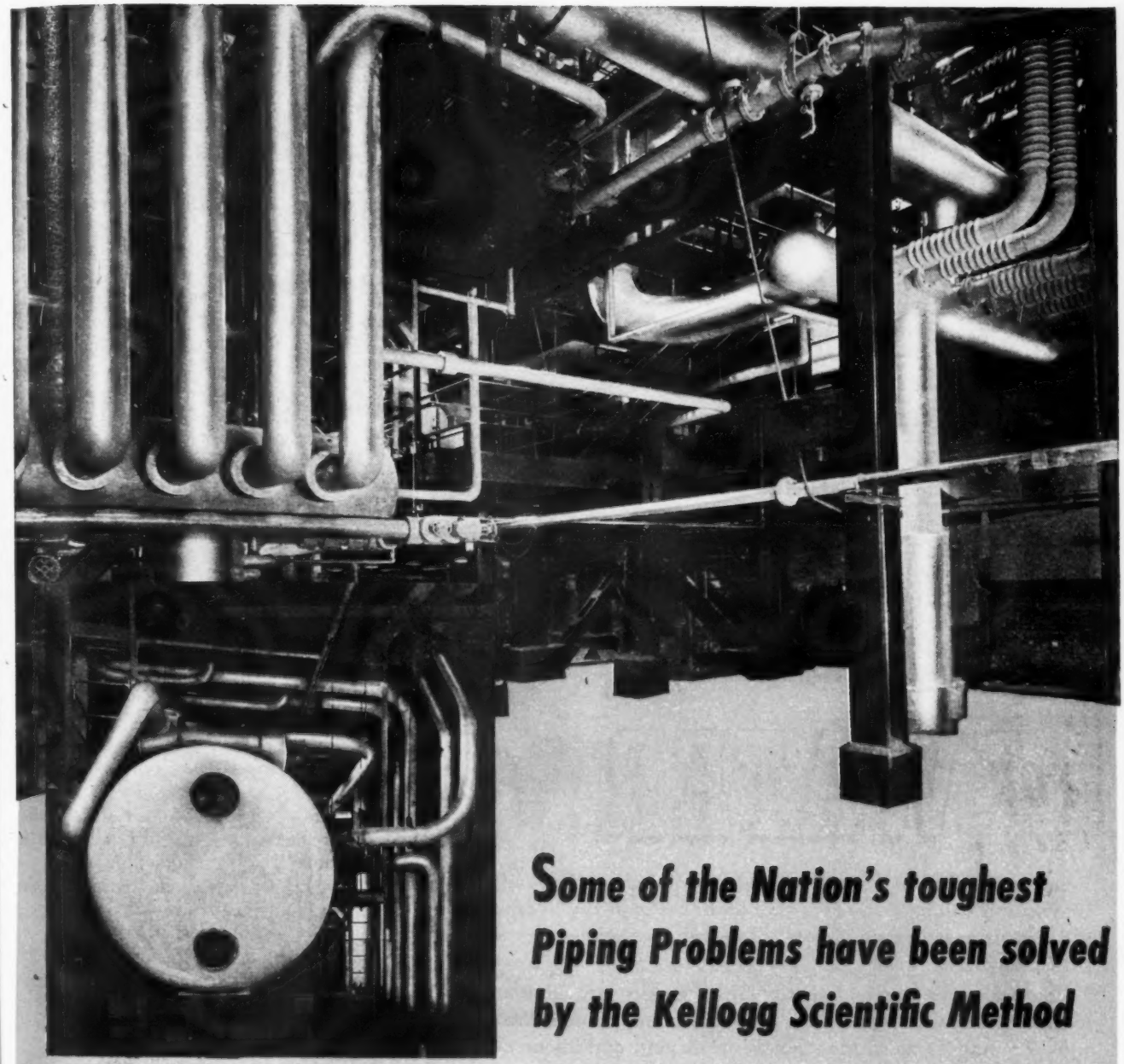
regulators are contained in one volume. Some of the subjects are: temperature rise, effect of altitude, ratings, insulation, temperature, tests, performance specifications, bushing characteristics, guides for loading, efficiencies and losses, accessories, terminal markings, and a section on definitions of terms.

METALLIZING HANDBOOK. *Published by Metallizing Engrg Co, Inc, 38–14 30th St, Long Island City 1, N. Y. 80 pages, profusely illustrated with photos and diagrams.* $1.00. For present and potential users of the metallizing process. Covers every phase from surface preparation to spraying techniques and the finishing of sprayed metal coatings.

CATALOG OF TECHNICAL BOOKS. *Issued by The Chemical Pub Co, Inc, 26 Court St, Brooklyn 2, N. Y. Available on request.* Lists the latest books on chemistry, technology, physics, general science, mathematics, engineering, radio, aviation, foods, gardening, medicine, metals, technical dictionaries. Gives date of publication, concise description of each book and full table of contents.

LIGHTING HANDBOOK. *Issued by Westinghouse Elec & Mfg Co, lamp div, Bloomfield, N. J. 175 pages, case-bound with leatherette cover,* $1.00. For lighting engineers, designers, architects and builders. Prepared by the company's illuminating engrg dept. A series of charts coordinate room index, fixture efficiency and coefficient of utilization curves, and provide a new and graphic method of determining desired illumination for various applications. Charts cover industrial and commercial fluorescent and incandescent lighting; give a means of calculating quickly number and size of lamps needed with practically every type of fixture. Part I contains Lighting Terms and Measurements, Recommended Levels of Illumination, Interior Lighting Design Calculations, Interior Wiring for Lighting; Part II, specific lighting applications, covers store, office, school, public buildings, industrial, architectural, aviation and street and highway lighting.

SOURCE DATA ON MUNICIPAL WATER TREATMENT PLANTS IN THE U. S. *By M C Schwartz, Ph D, Asst Professor, Chemical Engrg, Research Associate in Water Technology, Louisiana. Engrg Experiment Station Bulletin Series, No. 5. Published by Louisiana State University Press, Baton Rouge, La. 52 pages,* 50¢. Bibliography of municipal water treatment plants tabulated according to cities. The information is an outgrowth of data collected by the writer's students who have been regularly assigned report work on such plants.



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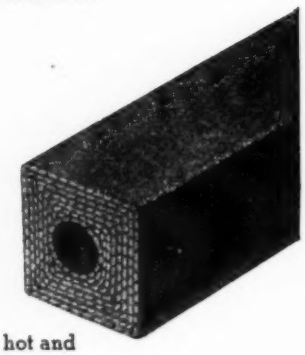

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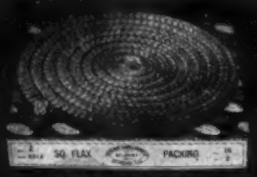

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Power Transformers

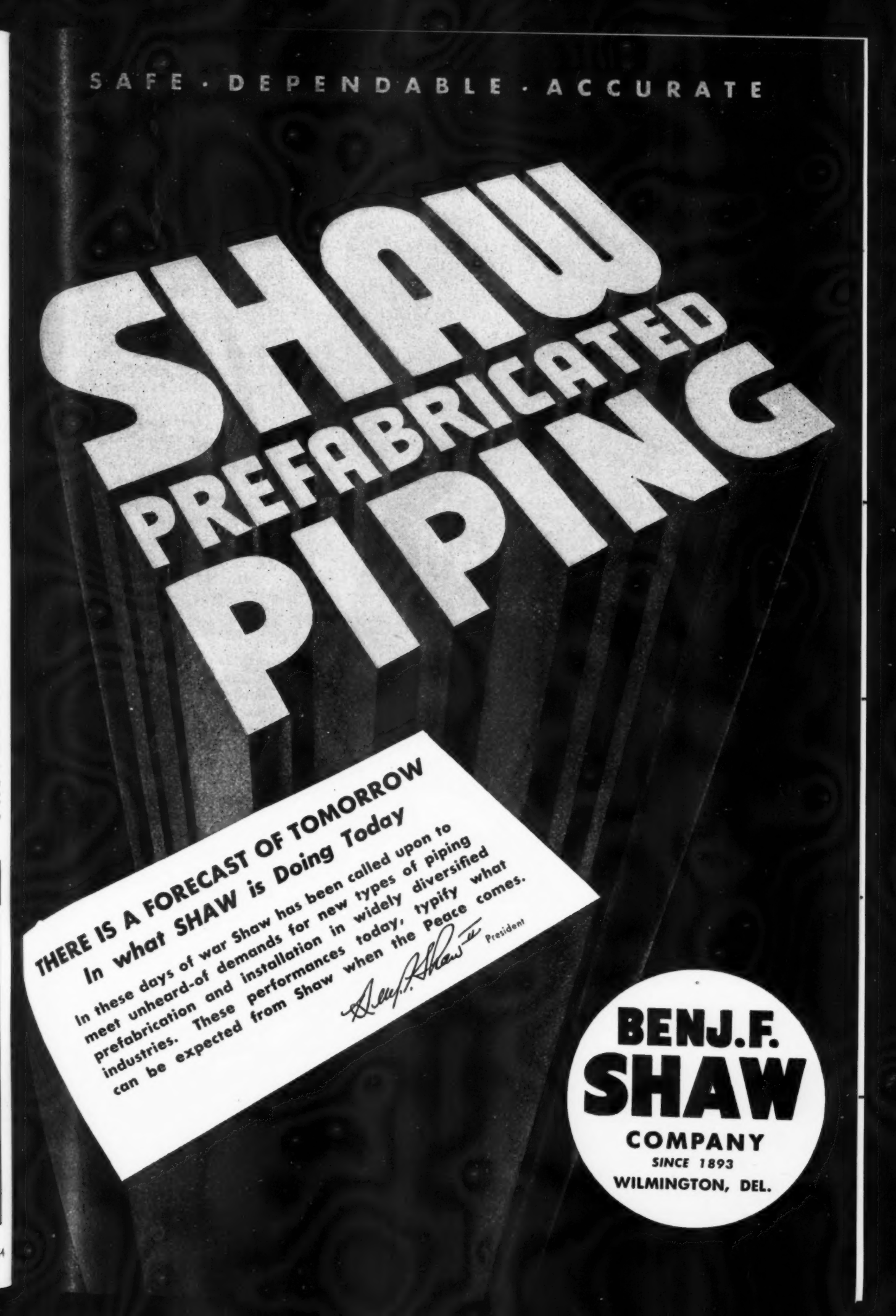
(*Continued from page* 102)

have higher hot-spot temperature gradients and shorter thermal-time constants than those used to determine the curves, Fig. 1. The chart, Fig. 2, is for such transformers, having a 30-C copper hot-spot gradient at full load, a 35-C oil rise, a ratio of copper to iron loss of 2 to 1 at full load and a 2-hr thermal-time constant.

Checking the previous load cycle on the chart, Fig. 2, a 30-C oil rise on the 100% load curve corresponds to a time of 3.3 hr, point *A*, at which the copper hot-spot rise is 60 C. Two hour operation at 100% load goes to time 5.3 on the load curve, point *B*. From *B* follow parallel to the 30-C oil-rise curve to the 140% load curve, point *C*, which corresponds to time 1.8 hr. Follow the 140% load curve for 1 hr to the right to point *D*. Here the oil rise is 43 C and the copper hot-spot reaches 95 C. Now follow to the right, parallel to the 40-C oil-rise curve, to the 80% load curve, point *E*, which corresponds to time 4 hr. One hour to the left along the 80% load curve arrives at point *F*, time 5 hr. At the end of the load cycle, copper rise will be 59 C and oil rise 38 C.

Load time and copper temperatures for this load cycle are tabulated in Table III. During the 140% load the final time was 2.8 hr and the copper hot-spot temperature 105 C. As these values are within the limit of 8 hr and 105 C, it is safe to operate the transformer on this load cycle. Any increase in ambient temperature above 10 C causes the transformer's temperature to approach unsafe values.

DON'T BE AN ACCIDENTEE!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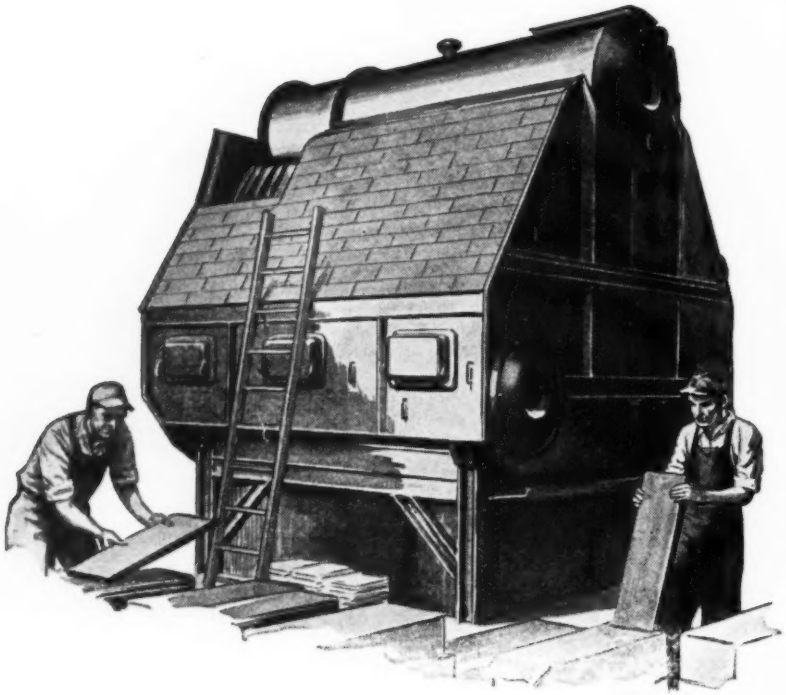

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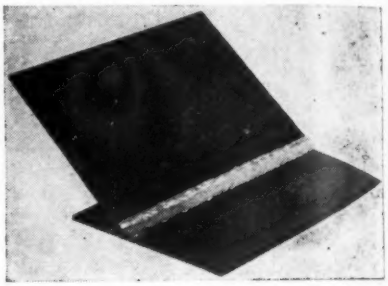
New Equipment

(*Continued from page* 126)

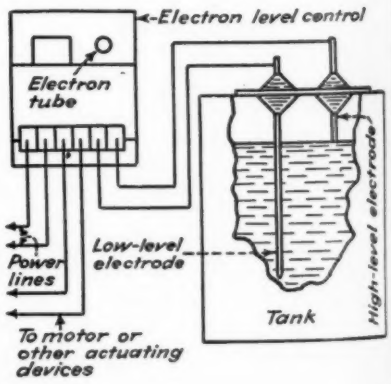
stacks. Model A Agitair hot-water generator has 400- to 1000-sq ft of radiating surface; larger capacities are available. *Air Devices, Inc,* 17 *E* 42*nd St, New York* 17, *N. Y.*

Welding Electrode

FLEETWELD 37 is a general purpose arc-welding electrode for welding mild steel in all positions, with either ac or dc. An advantageous feature is that there is no slag interference when welding vertical down. Ability of electrode to withstand higher currents makes possible higher welding speeds than nor-



mal. The fact that with proper currents it will neither stick to work nor burn through makes it especially desirable for light-gage welding. Electrode is available in ⅛- 5/32- and 3/16-in. sizes, in 14-in. lengths. *Lincoln Electric Co, Cleveland, Ohio.*



Level Control

UTILIZING ELECTRONIC PRINCIPLES, level control maintains, or keeps within desired limits, level of any liquid or electrically conducting solid within an open or closed tank, bin, hopper or other container. It indicates the level by signals or may be installed to operate solenoid or motor-driven valves, pumps, lights, bells or other electrical devices. It has no moving parts and has no chemical or

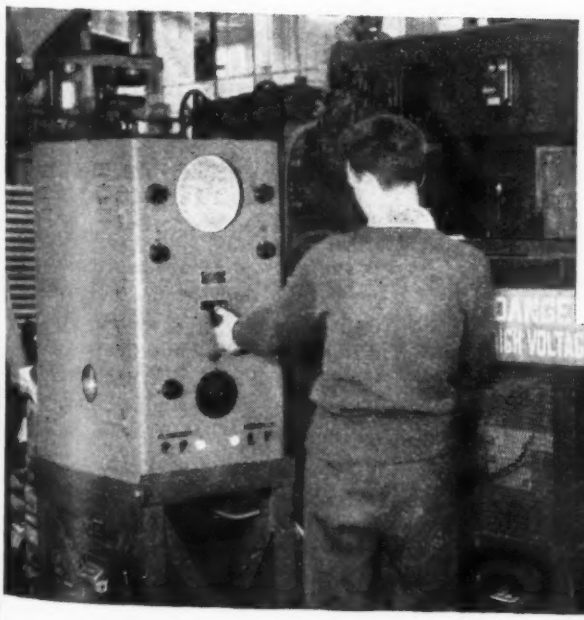
SHORTS STYMIED

Voltage surges which accompany switching and frequent starting and stopping of motors impose high dielectric stresses on the coil insulation, and can cause harmful short circuits. Yet this is an unavoidable condition of service for many motors.

The grinder shown here, for example, starts and stops every time a finished part is removed and a new part inserted. But the two Tri-Clad motors that drive it have been built to withstand safely the voltage surges ordinarily encountered in this type of service. Their ability to "stymie" shorts was proved by *the new General Electric test* described below.

External grinder, equipped with two Tri-Clad motors, installed in the milk-machinery manufacturing plant of the Rite-Way Products Company, Chicago, Ill.

New high-potential, electronic surge-tester verifies strength of TRI/CLAD motor windings

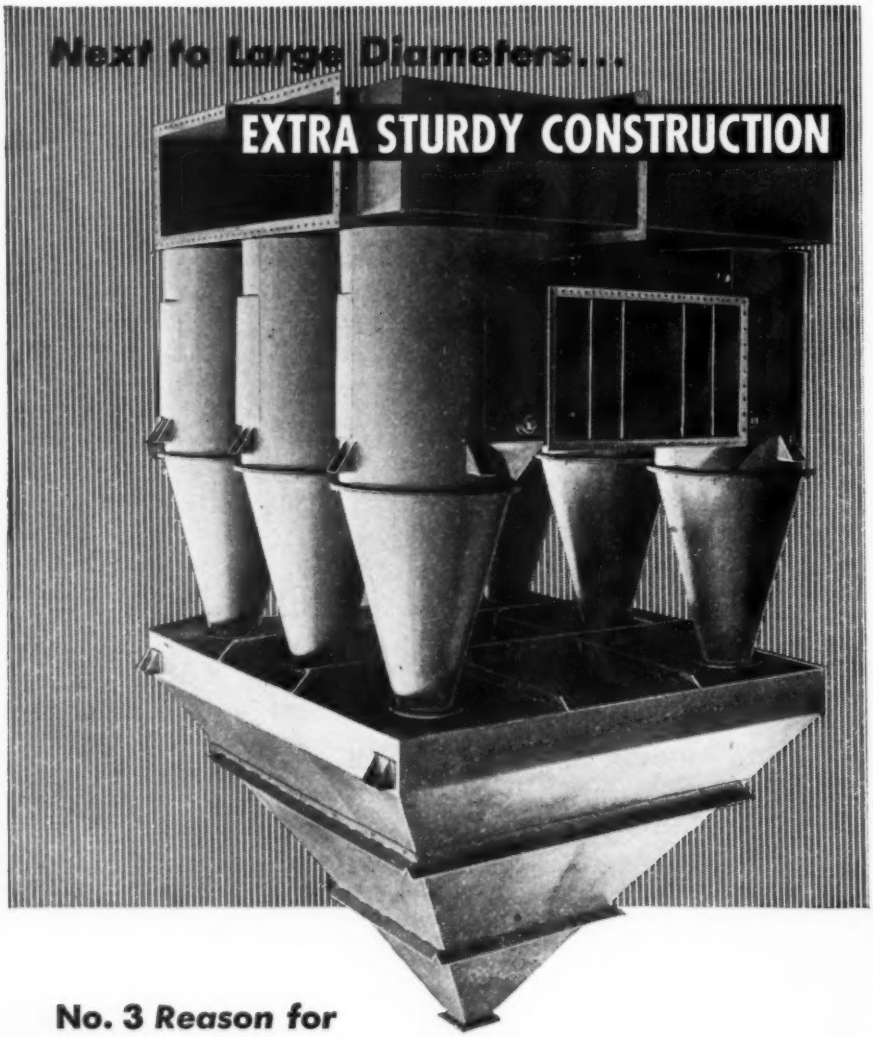


This electronic test of insulation makes a "cardiogram" of every Tri-Clad motor winding, ferreting out weaknesses that might lead to shorts caused by voltage surges in service. It tests each turn, coil, and phase group of the windings for adequate insulation strength to withstand the "steep front" high-voltage surges of actual service. First developed and applied by G.E., it's one of the production tests which all Tri-Clad motors must pass as they come off our production lines. – *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

TRI/CLAD MOTORS

Each week 192,000 G-E employees purchase more than a million dollars' worth of War Bonds.



No. 3 *Reason for*

Buell's High Efficiency, Low Maintenance, Long Life

To stand up under the severest conditions of continuous usage, cyclone bodies and cones in Buell Dust Recovery Systems are fabricated of extra-thick steel, completely seal-welded inside and out and ground flush to form a smooth, homogeneous surface. Hoppers are braced and stiffened with 3" channels to resist vibration.

This extra-sturdy type of construction is possible only with large-diameter cyclones and is one of the plus values that have made Buell Dust Recovery Systems famous throughout industry for long life and low maintenance. Due to their sturdy construction Buell installations have been in service three, four, five or more years without the replacement of a part.

How the patented "shave-off" of the van Tongeren cyclone (found only in Buell Dust Recovery Systems) makes it possible to use large diameters and, at the same time, obtain high collection efficiencies is fully described in a 28-page book: "The van Tongeren System of Industrial Dust Recovery." To secure a copy, simply write us for Bulletin G-842.

BUELL ENGINEERING COMPANY, INC.
10 Cedar Street, New York 5, N. Y.
Sales Representatives in Principal Cities

buell
DUST RECOVERY SYSTEMS

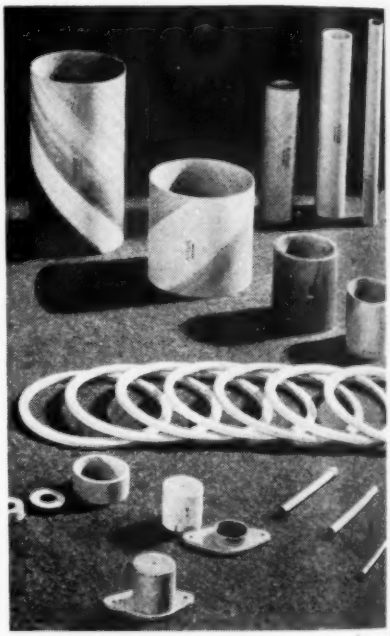
BUELL FEATURES	RESULT IN	PRODUCE
SHAVE-OFF LARGE DIAMETERS	HIGH COLLECTION EFFICIENCY	GREATER RECOVERY
EXTRA-THICK METAL	LESS FAN BLADE WEAR	LOW MAINTENANCE
LARGE OUTLETS	LOW DRAFT LOSS	LOW OPERATING COST
INNER WELDS GROUND SMOOTH	LOW POWER CONSUMPTION	LONG LIFE
CORRECTLY DESIGNED HOPPERS	HIGH TEMPERATURE RESISTANCE	NO CLOGGING
SPLIT-DUCT MANIFOLDS	UNLIMITED CAPACITY	
	NO MOVING PARTS	
	FREE DUST FLOW	

DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

other effect on liquids or solids being controlled. Control may be installed in evaporators, freezers, boilers or other containers involving extreme temperatures. Various combinations of single- and double-electrode installations are available. *Trimount Instrument Co, 37 W Van Buren St, Chicago 5, Ill.*

Rotary Pumps

STREAMLINED UNIT base saves space and has added utility. Fabricated base, made of welded-steel plate, permits free access to pump for lubrication and other service operations. Pump has a capacity of 100 gpm at 100 psi and is powered by a 15 hp gearhead motor, having a speed of 440 rpm on pump shaft. Unit handles oils on landing boats and industrial applications are being considered. *Blackmer Pump Co, Grand Rapids 9, Mich.*



Plywood Tubing

PLYTUBE IS A PLYWOOD TUBING fabricated from thin veneers and a thermosetting synthetic resin. According to manufacturer, Plytube floats; it has a specific gravity of considerably less than 1.0. It is also claimed that Plytube will carry a much heavier load than steel tubing. Most of its applications have been in round tubing, although it is possible to manufacture straight and tapered Plytube whose cross-sections are of other shapes. Because of its plastic-bonding agent, tubing is waterproof, flameproof, splinterproof and rotproof. It has low electrical conductivity and is dimensionally stable under extreme temperature ranges, which do not affect the thermosetting adhesive. By coating Plytube, it has been em-

STOP FIRE AND EXPLOSION HAZARDS

...with GROVE *Automatic* STOP VALVES

Fire and explosion hazards resulting from momentary interruption and uncontrolled restoration, or caused by the escape of large volumes of combustible gas due to line fractures or leakage can be eliminated through the use of Grove Automatic Stop Valves. Employed on lines carrying fuel to boilers, ovens, furnaces, on air, acetylene and oxygen supply lines to prevent loss of required system pressure, Grove Valves are designed to automatically stop the flow, operating on rate of flow, differential pressure or on static line pressure. For full details write today for Bulletin 515.

GROVE PRESSURE CONTROL SYSTEMS AND EQUIPMENT INCLUDE:

- ★ AIR, GAS AND STEAM PRESSURE REDUCING VALVES
- ★ REMOTE CONTROL SHUT-OFF VALVES
- ★ AUTOMATIC REDUCING AND STOP VALVES
- ★ FLEXIBLE TUBE TYPE VALVES
- ★ COMPLETE PRESSURE CONTROL SYSTEMS

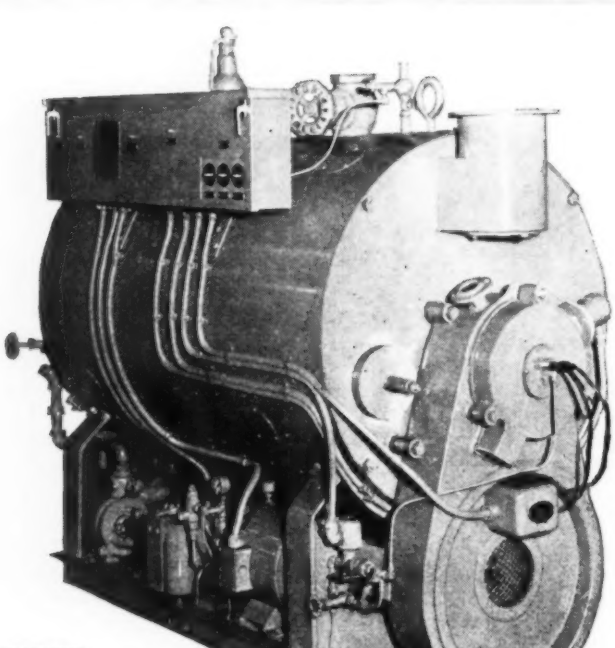
GROVE

GROVE
SIMPLICITY
ACCURACY
SAFETY

Pressure and Flow Control
SYSTEMS & EQUIPMENT

GROVE REGULATOR COMPANY
6547 GREEN STREET, OAKLAND (8), CALIFORNIA
BRANCH OFFICES: 5644 NAVIGATION BLVD., HOUSTON (11), TEXAS; 30 ROCKEFELLER PLAZA, NEW YORK CITY (20), N. Y.

DOLLAR EFFICIENCY – work done per dollar spent – measures the value of a steam generator



30 horsepower Cyclotherm widely used by U. S. Government

Cyclotherm is a self-contained, fully automatic steam generator for processing, power or heating that marks a new high in Dollar Efficiency.

Exclusive principles of combustion and operation assure high efficiency at low operating costs to owners of Cyclotherms. It is a steam generator built to make each unit of fuel produce more steam, to save hours of attendance, to deliver highly efficient, trouble-free service for years. Hundreds of them have proved their economy and dependability under the most difficult wartime operating conditions.

Cyclotherms are manufactured in units from 10 to 300 horsepower up. They are oil or gas fired. Some units are available now and deliveries are being made as rapidly as the press of Government orders permits. If you are planning replacements, our engineers will be glad to consult with you on any problem you may have. Write or call for additional information or any business or technical data you may wish.

CYCLOTHERM
STEAM GENERATOR

AMES IRON WORKS
OSWEGO . . NEW YORK . . BOX 102

ployed to carry chemicals, as well as for gasoline and oil containers and conduit. Plytube manufactured at present time with ½- to 18-in. inside diameters, in .05- to .50-in. wall thicknesses and in any reasonable length. These limits are temporary, however, and will probably be increased. *Plymold Corp, Lawrence, Mass.*

Iron Valves

AIR FURNACE MALLEABLE-IRON VALVES, for 150 psi at 450 F, are claimed to have toughness and fracture-resisting properties that nearly equal steel valves and provide effective protection against costly valve breakage and service interruptions. Company also states that valves have greater corrosion resistance than carbon steel and cast iron. *Jenkins Bros, 80 White St, New York 13, N. Y.*

Fire Extinguisher

CARBON-DIOXIDE FIRE EXTINGUISHER requires only one hand to operate. Randolph "4," latest in company's 4-lb CO_2 series, has a self-aimed, fixed-discharge horn and a thumb-operated trigger valve that releases a penetrating blanket of carbon dioxide. This design, according to maker, makes it one of the fastest-firing extinguishers manufactured. *Randolph Laboratories, Inc, 8 E Kinzie St, Chicago, Ill.*

Safety Tools

NON-SPARKING SAFETY TOOLS redesigned for strength. Tool design is such that at points where weakness might normally appear, strength values are increased. Tools, made of copper-base alloy, are ideal wherever explosive fumes, gases and dust are present. *Ampco Metal, Inc, Milwaukee, Wis.*

New Catalogs, Booklets and Bulletins to Bring Your Equipment Library up to Date

For Your Convenience

Two business - reply cards are printed here as a part of this insert. On each is room for you to request four pieces of literature.

How to Order

1. If you are requesting four pieces or less, please use only the bottom card. Likewise, for four to eight pieces, use both attached cards.

2. Be sure to fill one of the eight spaces for each piece you order. This will assure your receiving copies of literature promptly by reducing amount of clerical work in handling your request.

3. When you have filled out one space for each catalog or bulletin you want, detach along the scored lines and drop the cards in the mail. No postage is required.

Example

Write in circle number of item describing one catalog wanted → (17)

Your Company Name Brown Mfg Co.

Address 318 First Avenue

Pottsville, Okla.

Your Name John Smith

Your Title Power Engineer

POWER, 330 West 42nd St., New York

Please fill out *each section* of the coupon completely, for each bulletin you wish. Coupons not completely filled out will not be handled. These cards void after June 1, 1944.

AIR CONDITIONING, HEATING, REFRIGERATION AND VENTILATING

1 VACUUM-COOLING EQUIPMENT — Elliott Co, Jeannette, Pa. 8-page bulletin No. G8 gives advantages and application possibilities of cooling by vacuum. Chart shows relationship between temperature pressure and water-vapor volume within normal-temperature range for vacuum cooling. Five essential parts of a vacuum-cooling unit are described.

2 UNIT HEATERS—Electric Air Heater Co, 555 S Byrkit St, Mishawaka, Ind. Bulletin describes construction, operation and application of two new models of Electromode industrial unit heaters. Specifications, drawings and other data are also outlined.

3 FILTERS—Dollinger Corp, Rochester, N. Y. 44-page catalog No. 209 covers company's industrial and ventilation filters. Ventilating section tells how to keep out dust and save money. It covers automatic air-filtration panels. Wire Klad and fiber-frame filters, window ventilators. Industrial section describes how to cut your operating costs and contains data on radial-fin inserts, intake, silencer and pipeline filters and special designs.

BOILERS AND AUXILIARIES

4 BOILER-WATER COLUMNS — Reliance Gauge Column Co, 5902 Carnegie Ave, Cleveland 3, Ohio. 12-page catalog No. 415 describes boiler-water columns with and without alarms, for pressures above 250 psi. Boolet also contains water-gage equipment.

5 REFRACTORIES—M D Valentine & Bro Co, Woodbridge, N. J. 12-page catalog contains data on Valentine refractories for boiler settings, oil stills, heat-treating furnaces, incinerators, air-cooled furnaces, suspended arches and special furnaces.

6 FIRE-CLAY BRICKS — McLeod & Henry Co, Troy, N. Y. 4-page bulletin introduces three new fire-clay brick products, Hyex, Super-Hyex and Superam. Tabulation gives available brick sizes.

7 REFRACTORY COATINGS — Armor Clad Co, 39 Hyatt Ave, Newark 5, N. J. 8-page leaflet discusses Armor-Clad monolithic coatings for protection to both new and old furnace walls. Pamphlet lists causes of refractory-wall failures.

CONTROLS, ELECTRIC

8 ELECTRONIC CONTROL — General Electric Co, Schenectady, N. Y. 12-page bulletin No. GEA-4126 explains fundamental principles and operation of electronic tubes. Publication describes thyratron-tube construction and lists eight functions of industrial tubes. Advantages of electronic control are also included.

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Your Name.....

Your Title.....

POWER, 330 West 42nd St., New York 6/44

9 AUTOMATIC CONTROLS — Synchro-Start Products, Inc, 221 E Cullerton St, Chicago, Ill. 36-page booklet discusses automatic controls for starting and stopping a power unit. Booklet shows a few of the many applications for which internal-combustion engines can and are being used to advantage.

10 POTENTIOTROLS — Wheelco Instruments Co, Harrison and Peoria Sts, Chicago 7, Ill. 8-page bulletin No. A2-3 describes potentiometer method of heat measurement and explains electronic principle employed in company's instruments to gain instant control.

CONTROLS, MECHANICAL

11 REGULATORS — Victor Equipment Co, 844 Folsom St, San Francisco, Calif. 8-page bulletin covers Gas-O-Dome regulator line. Chart for selection of regulator is included.

12 FEEDWATER REGULATOR—Northern Equipment Co, 1945 Grove Dr, Erie, Pa. 4-page folder No. 435 summarizes performance record of Copes Flowmatic, steam-flow water-level feedwater regulator.

13 DRAFT CONTROL—Preferred Utilities Co, 1860 Broadway, New York 23, N. Y. 16-page bulletin No. 800A shows how it is possible to save 10 to 30% in fuel consumption of natural-draft boilers by installation of Draft-A-Justor.

14 REGULATORS — Grove Regulator Co, 6529 Green St, Oakland 8, Calif. 16-page bulletin No. 123A features Powreactor dome regulator for controlling air, gas and liquids at high pressures.

15 REGULATORS — Grove Regulator Co, 6529 Green St, Oakland 8, Calif. Bulletin No. 125-A describes Grove Series 15 regulators for applications requiring accurate, small-capacity regulation at high pressures in various control combinations.

16 MECURIAL THERMOSTATS—Bender Scientific Glass, Inc, 2529 N Carlisle St, Philadelphia 32, Pa. Bulletin No. 344 gives specifications of Benderstat temperature controls.

17 TEMPERATURE CONTROL — Carrier Corp, Syracuse, N. Y. 8-page brochure gives specific problems and solutions of temperature and humidity control in eight industries.

ELECTRICAL EQUIPMENT

18 SYNCHRONOUS MOTORS — General Electric Co, Schenectady, N. Y. 4-page bulletin No. GEA-4139 describes application and construction of low-speed synchronous motors. Booklet discusses synchronization, field removal and motor protection afforded by GE synchronous motor control.

19 SWITCHGEAR—Square D Co, 6060 Rivard St, Detroit 11, Mich. 28-page bulletin No. 3100 describes switches, panelboards, switchboards, regulators and special equipment for protection and control of generators, power- and lighting-distribution systems, etc.

20 MERCURY-ARC RECTIFIERS—General Electric Co, Schenectady, N. Y. 36-page bulletin No. GEA-3796 gives design, mechanical construction, operation and successive steps involved in manufacture and assembly of GE ignitron mercury-arc rectifiers.

21 LOAD-CENTER UNIT SUBSTATIONS—Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 16-page bulletin No. B6285, entitled *Packaging Pays Off*, describes standardized load-center unit substations of 100- to 2000-kva capacity. Unique feature of booklet is a simple nomogram for selecting correct air-circuit breaker for any application of a standardized load-center unit substation.

22 FLUORESCENT LAMP—Sylvania Electric Products, Inc, Ipswich, Mass. 4-page leaflet discusses new P-7 fluorescent extension-cord lamp for close work and inspection in confined working areas.

23 POWER-FACTOR CORRECTION CHART—George S May Business Foundation, 111 S Dearborn St, Chicago 3, Ill. 8-page booklet No. 146, entitled *Preventing and Correcting Low Power Factor*, introduces a new, automatic device, the *Power-Factor Correction Chart*. Pamphlet also covers history of electric-power development.

24 AIR-CIRCUIT BREAKER — I-T-E Circuit Breaker Co, 19th and Hamilton St, Philadelphia 30, Pa. 36-page catalog No. 1002 includes sections covering selection and construction of company's low-voltage air-circuit breakers. Section on protective devices describes tripping mechanisms.

25 GENERATORS AND EXCITERS—General Electric Co, Schenectady, N. Y. 4-page bulletin No. GEA-1607D describes direct-current generators which may also be used as exciters. Photographs help explain construction of each model.

26 DISTRIBUTION TRANSFORMERS—General Electric Co, Schenectady, N. Y. 12-page bulletin No. GEA-3714B describes dry-type transformers for 601- to 15,000-v circuits. Standard GE dry-type transformers in smaller ratings are also listed.

27 BALANCING EQUIPMENT—Vibroscope, Inc, 6 E 39th St, New York 16, N. Y. 4-page bulletin No. 12-V describes improved Davey portable-balancing equipment for steam turbines, electric motors, hydro generators, fans and blowers, motor generators, gears and couplings, machine parts.

HEAT EXCHANGERS

28 HEAT EXCHANGERS — Brown Fintube Co, Elyria, Ohio. 6-page bulletin No. 432 discusses improved BFT-U sectional-hairpin heat exchangers. It describes non-removable rear-end assembly in new exchangers, which is said to permit easy and quick entrance into exchanger for inspection, cleaning, etc.

MAINTENANCE AND SAFETY EQUIPMENT

29 TOOLS—Robert H Clark Co, 3424 Sunset Blvd, Los Angeles 26, Calif. 8-page folder gives descriptions of new Clark counterbore and spotfacer, 3-blade adjustable hole cutter, 2-blade adjustable surface facer, 2-blade adjustable flycutter, adjustable gasket cutter and thread tool grinding fixture.

30 SAFETY GOGGLES—American Optical Co, Southbridge, Mass. 20-page booklet, entitled *Right on the Nose*, explains methods of adjusting non-prescription industrial safety goggles.

(*Continued on page* 172)

FIRST CLASS
PERMIT No. 10
(Sec. 510, P.L.&R.)
NEW YORK, N.Y.

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330 West 42nd Street
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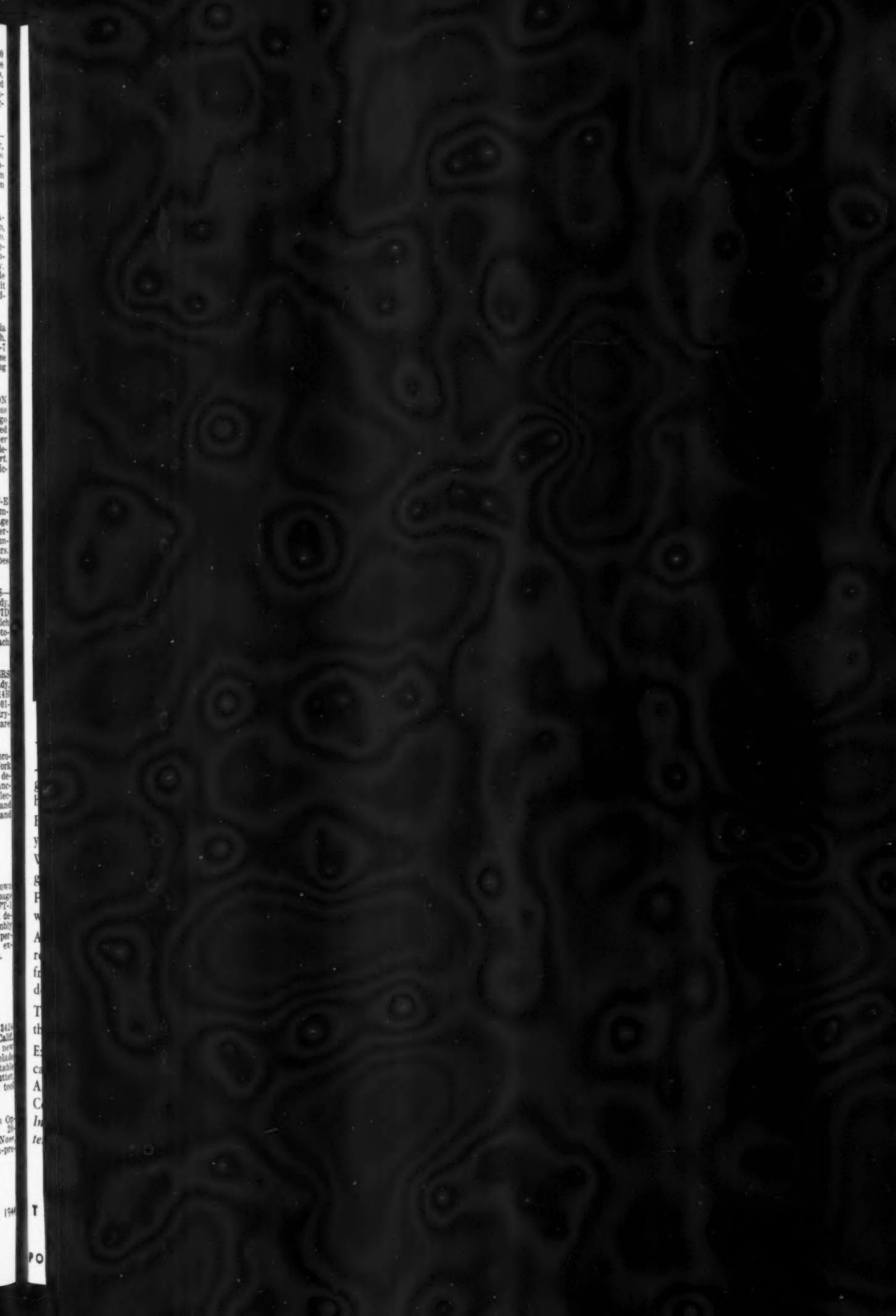


FEEL LIKE CRYING ABOUT THE COAL SHORTAGE? MAYBE YOU NEED TAYLOR EXHAUST STEAM CONTROL!

EVERY time you let too much exhaust steam go to the roof, you're wasting coal. And that alone is a good reason why you should investigate Taylor Exhaust Steam Control.

But if you don't let it go as soon as there is an excess, you also waste coal.

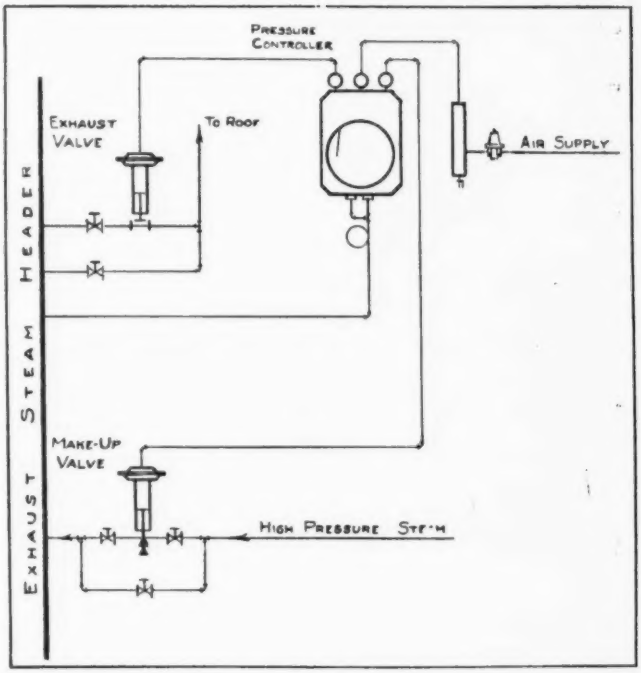
Why? Because the steam rate of engines and turbines goes up with increasing back pressure.

Putting off the evil moment simply means that there will be more steam to blow at the higher pressure.

A Taylor Exhaust Steam Control system opens the relief valve as soon as the pressure has increased a fraction of a pound above the desired pressure. It doesn't go out for a smoke.

The same controller closes the relief valve and opens the make-up valve when the pressure tends to fall.

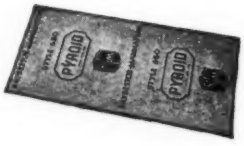
Exhaust Steam Control is only one of many ways you can profitably apply Taylor Accuracy to your plant! Ask your Taylor Field Engineer. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow and liquid level.*



TAYLOR INSTRUMENTS — MEAN ACCURACY FIRST

Turn With Confidence To R/M PACKINGS

Like many of us for the past year or two, R/M packings have had to take it. Steam lines, oil lines, fuel lines, and air lines have been carrying terrific pressures. Through it all, R/M packings have shown a performance-record that has more than repaid for many hours of laboratory work. Yes, when the war is over and we can again supply the normal demand, you can turn to R/M packings with greater confidence than ever.



ARMY E NAVY

INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
MANHEIM, PA.
BRIDGEPORT, CONN. NORTH CHARLESTON, S. C. PASSAIC, N. J.
Makers of Packings for Every Industrial Use

New Bulletins

(*Continued from page* 170B)

31 PURIFIERS—Honan Crane Corp, 608 Wabash Ave, Lebanon, Ind. 24-page catalog covers applications, advantages, specifications, etc, on Honan Crane continuous-oil purifier, fuel-oil purifier, automatic clarifier, mobile insulating-oil purifier, threadgrinding coolant purifier and other equipment.

32 VACUUM-CLEANING SYSTEMS—Allen Billmyre Co, 431 Fayette Ave, Mamaroneck, N. Y. 8-page bulletin No. D4 outlines benefits of Exidust central vacuum-cleaning systems for industrial plants and buildings.

33 FIRE EXTINGUISHERS—C-O-Two Fire Equipment Co, Newark 1, N. J. Pocket-size booklet, entitled *Recharging Instructions for Carbon-Dioxide Extinguishers*, is illustrated with drawings of equipment required for recharging and procedure to be followed in recharging both system cylinders and portable extinguishers.

34 ELECTRIC TOOLS—Skilsaw, Inc, 5033 Elston Ave, Chicago 30, Ill. Catalog gives suggestions on care and operation of portable electric tools. Manual discusses Skilsaw portable electric-tool line.

35 LUBRICATION—Calumet Refining Co, 4323 S Western Blvd, Chicago 9, Ill. 24-page booklet, entitled *25 Years With One Ideal*, traces lubrication history. Pamphlet explains Calumet's progress in oil refinement.

36 TOOLS—Kennametal Inc, 368 Lloyd Ave, Latrobe, Pa. Catalog No. 43C gives reduced prices of standard tools and blanks. Catalog discusses origin and characteristics of Kennametal, how to select proper grade, how to specify and order tools and blanks, information on chip breakers, instructions on brazing blanks to tools' shanks, proper grinding methods and milling of steel with carbide-tipped cutters of simple design.

MAINTENANCE MATERIALS

37 VARNISH—John C Dolph Co, 168 Emmett St, Newark, N. J. Pamphlet contains specifications of Synthite PG-4 clear baking varnish. Booklet also gives method of insulating electrical units and vacuum impregnation.

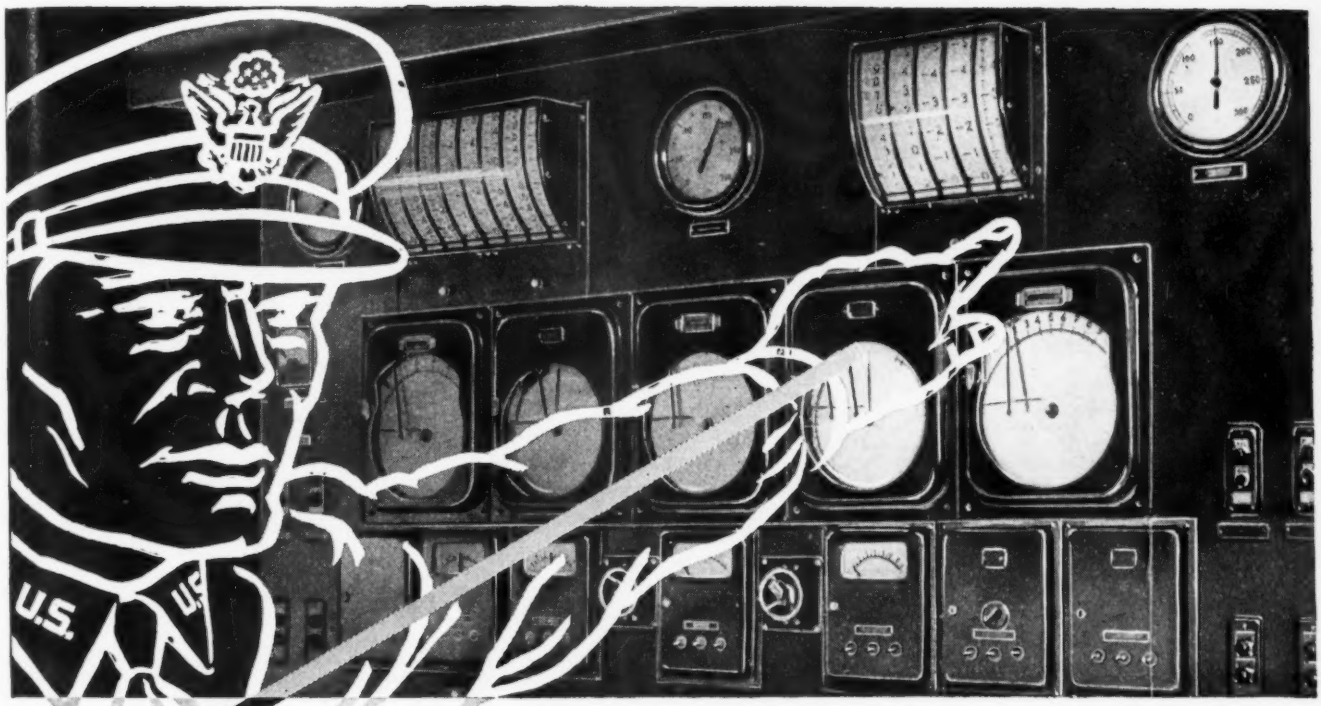
38 PROTECTIVE COATING—Geo R Mowat Co, 24 W 40th St, New York 18, N. Y. Leaflet describes Griffin's Hytemp for heat-treating operations. Coating is claimed to retard deterioration of refractories and other equipment subjected to extreme temperatures.

39 METAL COATINGS — Metallizing Engrg Co, 38-14 30th St, Long Island City, N. Y. Catalog No. 42B describes Metco metallizing guns, wires, surface-preparing tools and other accessories. In addition, it tells how sprayed metal coatings are saving critical materials and manpower in production and maintenance of parts and equipment.

40 PACKINGS—Greene, Tweed & Co, Bronx Blvd at 238th St, New York 66, N. Y. 4-page bulletin tabulates fluids handled in process work and general plant services and lists correct packing for each liquid, gas and vapor. Additional tabulation describes form and construction of each packing and lists equipment for which each one is suited. Tables on sizes and weights are included.

41 RUBBER PRODUCTS—Manhattan Rubber Mfg Div, Passaic, N. J. 140-page catalog describes mechanical rubber products and other items manufactured by Manhattan, many available only for postwar use. Particular emphasis is given belts, hose, molded goods, packing, lathe cut and extruded rubber goods, friction material, rubber covering and abrasive wheels.

42 SCALE REMOVER—Oakite Products, Inc, 23 Thames St, New York 6, N. Y. 28-page manual describes procedures for increasing output of equip-



USE THIS WINNING STRATEGY ON YOUR BOILER PLANT

THOSE perpetual foes of combustion efficiency—Excess Air, Fuel waste, High Operating Cost—haven't a chance against the strategy of Hays Automatic Combustion Control.

There's no guessing here, nothing left to chance. Your Hays Control System assembles *all* the data concerning combustion, measures all variable elements, and *regulates* them—automatically. It does that job better than man-power can do it—never absent, never overworked, never an unwary instant: smooth, faultless, *tireless* efficiency 24 hours every day.

Hays Combustion Control's greater service today is in putting youthful efficiency back into wasteful steam plants—making them *better* plants, safer plants, lower cost plants.

Smart strategy?—it never misses. The Hays Combustion Control Catalog explains how you can use it. Full of helpful steam-power data. Write for it today.

HAYS

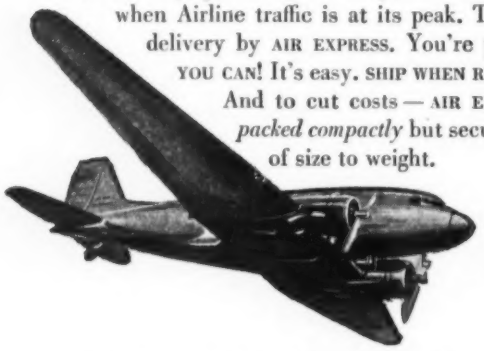
THE MODERN SYSTEM *It's Electrical*

Automatic COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, IND.

YOUR AIR EXPRESS shipments ought to be handled like hot potatoes, not "parked" on the floor awaiting a "routine" afternoon pick-up. Pack early, phone immediately, and avoid end-of-the-day congestion when Airline traffic is at its peak. That's the way to get fastest delivery by AIR EXPRESS. You're paying for speed... GET ALL YOU CAN! It's easy. SHIP WHEN READY!

And to cut costs — AIR EXPRESS shipments should be *packed compactly* but securely, to obtain the best ratio of size to weight.



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ment and shortening shutdown time by restoring normal heat transfer efficiency to gasoline- and diesel-engine cooling systems, lube oil and jacket water coolers, refrigerant condensers and compressors, surface condensers, etc. Booklet discusses Compound No. 32 for removing hard-water scales, rust and similar deposits from equipment.

MATERIALS HANDLING

43 PNEUMATIC ASH - HANDLING SYSTEM—Beaumont Birch Co, 1505 Race St, Philadelphia 2, Pa. 30-page catalog describes Vac-Veyor system for automatic removal by suction of ashes, fly-ash and soot. Booklet gives diagrams, dimensions and specifications of two sizes, in each of two types of system, for delivering ashes either dry or damp.

44 COAL AND ASH HANDLING — Link-Belt Co, 307 N Michigan Ave, Chicago, Ill. 30-page book No. 1510, entitled *Solving the Problem of Coal and Ashes Handling in the Boiler Plant*, discusses bucket elevators, elevators and screw conveyors, reciprocating feeders, belt feeders, apron feeders, Peck carrier, flight conveyors, bunket gates and spouts, silo storage systems, etc.

45 INDUSTRIAL LOCOMOTIVE—General Electric Co, Schenectady, N. Y. 16-page booklet No. GEA-4133 describes diesel-electric industrial locomotive for plants where loads are heavy, high speeds are unnecessary and clearances are close.

46 ELECTRIC TRUCKS—Philadelphia, div, Yale & Towne Mfg Co, Philadelphia, Pa. 76-page catalog contains descriptions of all truck models, as well as application photographs. Separate section explains War Production Board's Limitation Order No. L. 112, as applied to Yale industrial trucks.

47 WELDING CRANES — Whiting Corp, Harvey, Ill. 2-page bulletin, Unit 68, describes automatic welding cranes for handling of large welding jobs. Equipment photographs are included.

48 MATERIALS-HANDLING EQUIPMENT—Philadelphia div, Yale & Towne Mfg Co, Philadelphia 24, Pa. 60-page booklet, entitled *Modern Materials Handling Machinery Applied to American Industry*, deals with materials-handling problems most frequently encountered in industry.

49 BULK-FLOW CONVEYOR — Link Belt Co, Chicago, Ill. 32-page booklet No. 2075 points out that the Link-Belt Bulk-Flo combines the functions of conveyor, elevator and feeder in a single unit. Photographs show typical installations.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ TRUCK—Buda Co, Harvey, Ill. 8-page bulletin discusses construction of Model B Chore Boy. Folder contains photographic illustrations of truck in actual operation on many jobs. Copy will be sent only to industrial war plants.

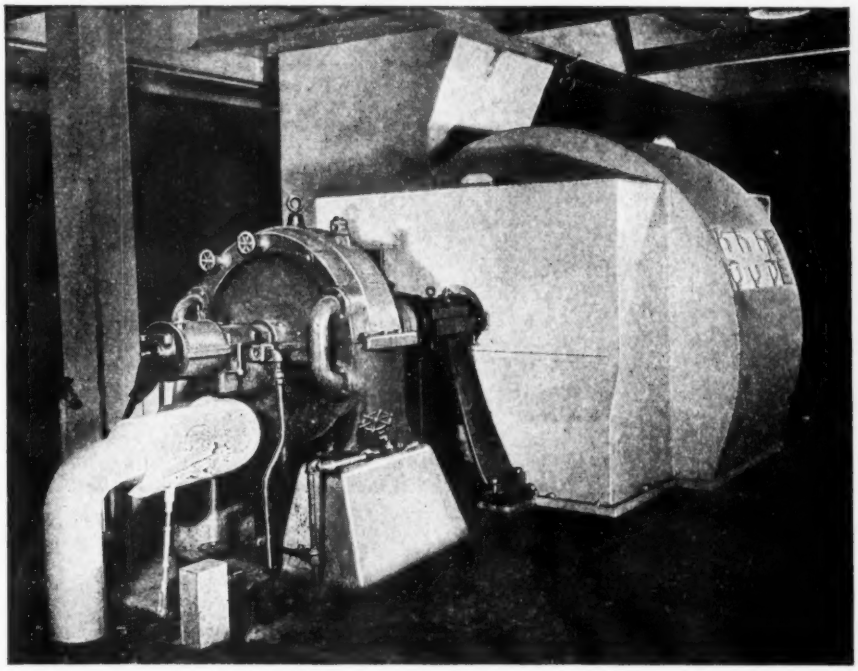
MECHANICAL TRANSMISSION

50 BALL BEARINGS—New Departure div, General Motors Corp, Bristol, Conn. 16-page booklet No. ND-A57, entitled *Service Procedure for Ball Bearings*, gives correct methods of handling bearings when overhauling equipment.

51 FLEXIBLE COUPLINGS — T B Wood's Sons Co, Chambersburg, Pa. Leaflet describes the universal giant Type B flexible couplings. Table is included on sizes, list prices, etc.

52 FRICTION CLUTCH—Hilliard Corp, 235 W 4th St, Elmira, N. Y. 4-page bulletin covers operation of Hilliard friction clutch. Typical clutch applications are given. Booklet also discusses company's friction cutoff coupling.

TERRY



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In the Terry Turbine the wheel is made from a single forging of special composition steel. The buckets are milled directly in the wheel. There are no parts to become loose or work out. Such construction makes for long life and low maintenance.

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ABOVE: 250 H.P. Terry Wheel Turbine driving Induced Draft Fan. Unit is one of ten Terrys installed in a mid-western plant.

T-1153

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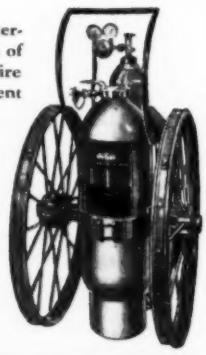
CHART showing characteristics of all types of approved hand fire extinguishers sent free on request.



MODEL 150 WHEELED EXTINGUISHER

DUGAS ENGINEERING CORPORATION, MARINETTE, WISCONSIN
OWNED AND OPERATED BY ANSUL CHEMICAL COMPANY

53 SHEAVE—Allis-Chalmers Mfg Co, Milwaukee 1, Wis. 4-page bulletin No. B6310 introduces new Magic-Grip sheave. Six photographs demonstrate sheave installation and removal.

54 UNIVERSAL JOINTS — Condenser Service & Engrg Co, 95 River St, Hoboken, N. J. 8-page bulletin No. CS-10 describes new bevel-gear universal joints for remote control of valves, pumps, engines, antennae, ventilators and other equipment in inaccessible locations or for centralized control of widely separated units. Booklet also gives data on brackets and shaft hangers.

55 SINGLE-REVOLUTION CLUTCH—Hilliard Corp, 235 W 4th St, Elmira, N. Y. 4-page bulletin discusses single-revolution clutch for automatic, positive, non-slipping intermittent machine rotation from a continuously rotating power source. The two most common methods of applying the clutch to a machine are given.

56 OVERRUNNING CLUTCH—Hilliard Corp, 235 W 4th St, Elmira, N. Y. 4-page bulletin gives construction and typical applications of Hilliard overrunning clutches and couplings.

57 CHAIN DRIVES—Morse Chain Co, Ithaca, N. Y. Bulletin No. 43 discusses advances and new developments in high-speed chain drives and other fields, in addition to usual specifications and price lists. A section on installation and maintenance is included. Condensed data covering other Morse power-transmission equipment serves as a supplement.

58 CENTRIFUGAL CLUTCH—Hilliard Corp, 235 W 4th St, Elmira, N. Y. 4-page bulletin outlines Hilliard centrifugal-clutch operation and includes a discussion of typical applications.

59 CHAIN-BELT DRIVES—Chain Belt Co, Milwaukee, Wis. 20-page bulletin No. 435, entitled *"Wartime Care of Chain Belt Drives,* gives helpful suggestions on getting the most out of existing drives. Adequate lubrication and correct alignment instructions are included. Check chart lists symptoms of drive troubles, possible causes and remedies.

60 BALL BEARINGS—New Departure div, General Motors, Bristol, Conn. Booklet R cotains lists of ten competitive makes of ball bearings, together with corresponding New Departure numbers. Booklet includes a table of bearing dimensional tolerances; section on prefixes and suffixes used with each make of bearing; comparative bearing type and series numbering systems; interpretation of New Departure bearing numbers for applying numerical designations to bearing characteristics.

METALS AND ALLOYS

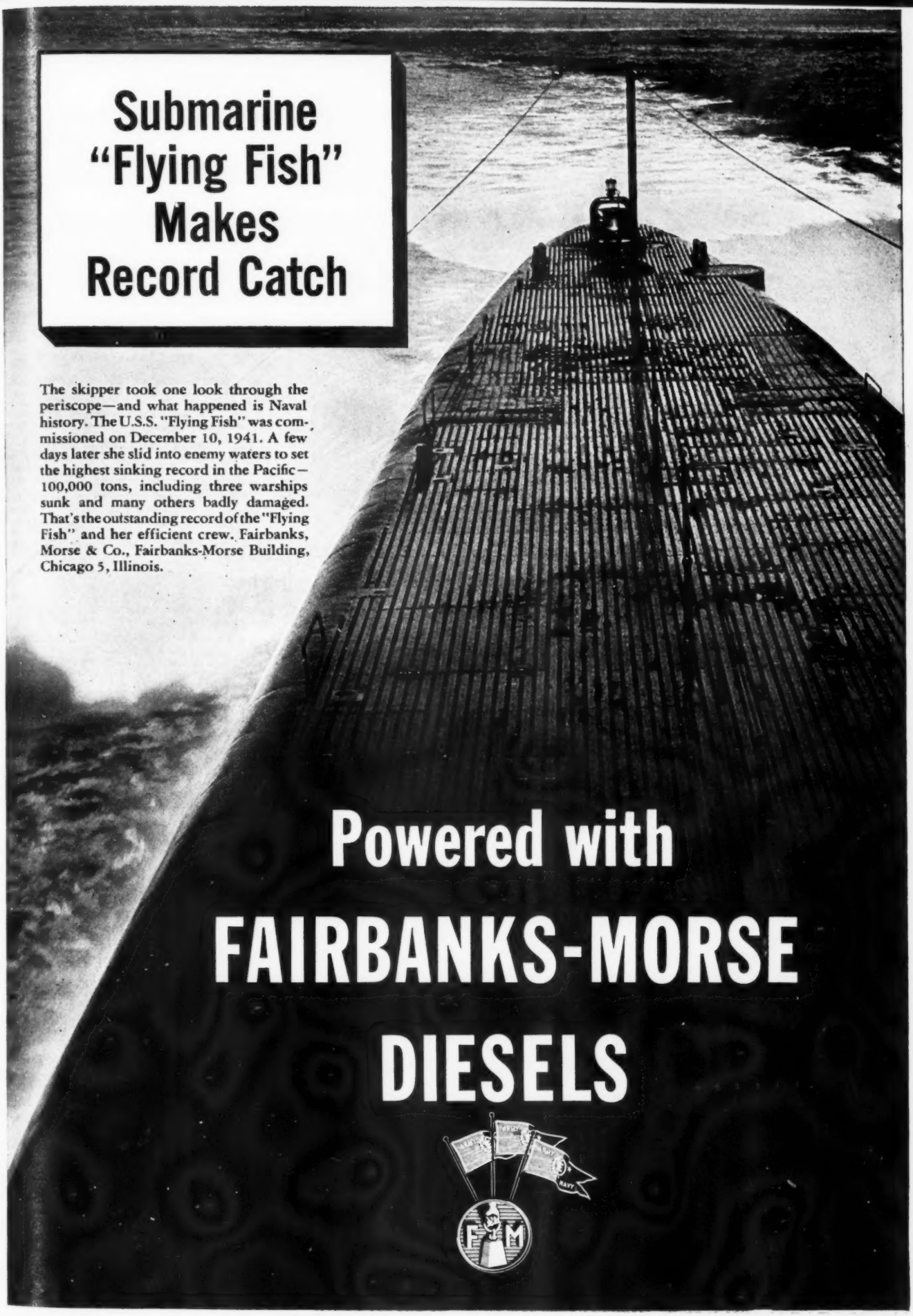
61 STEEL—Earle M Jorgensen Co, 10510 S Alameda St, Los Angeles 54, Calif. Booklet contains all the data required to determine or check prices of steel purchased from Jorgensen warehouse stock.

62 STEEL—Jessop Steel Co, Washington, Pa. Catalog contains information on analyses, applications, manufacture, fabrication, styles of heads and standard size of Jessop stainless-clad steel sheets and plates. It also gives a comprehensive explanation of the patented *assembly method* of producing the metal.

METERS, AND INSTRUMENTS, MECHANICAL

63 FLOWMETERS — Cochrane Corp, 17th and Allegheny Ave, Philadelphia 32, Pa. 16-page booklet No. 29, entitled *Flow Meter Engineering,* tells why, when and where flowmeters and instruments are needed in the modern plant and how they can be made to further the war effort.

64 THERMOMETERS—Johnson Service Co, Milwaukee 2, Wis. 16-page catalog lists and discusses straight-shank, and angle-pattern thermometers for liquids; adjustable-angle thermometers for air; and dial thermometers for air and liquids.



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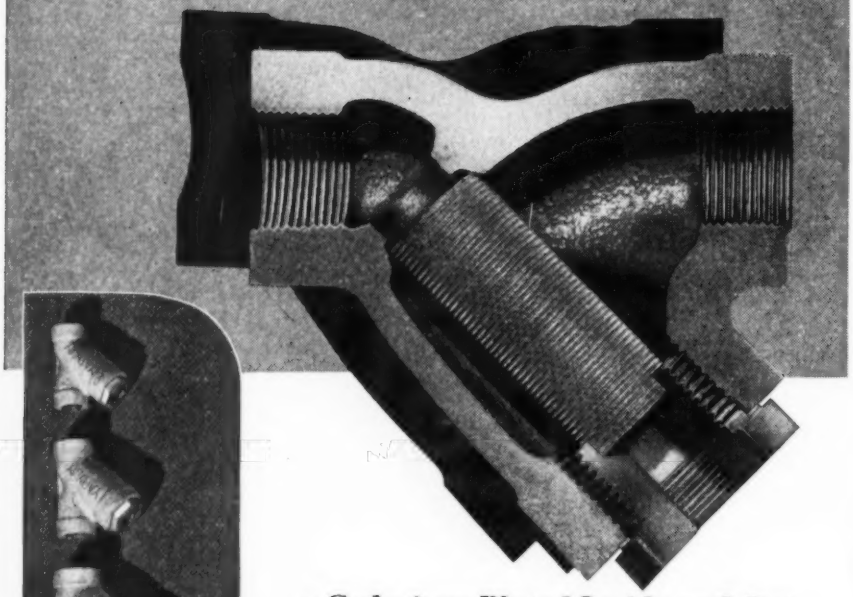

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YARWAY STRAINERS

65 GAGE COMPARATOR—Grove Regulator Co, 6529 Green St, Oakland 8, Calif. 8-page bulletin No. 300 gives Grove gage-comparator operation for testing pressure gages.

66 pH RECORDERS—Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa. 16-page catalog No. 4-96(1), entitled *Micromax pH Recorders*, gives principle, design, installation and application of equipment.

67 PYROMETER ACCESSORIES—Bristol Co, Waterbury 91, Conn. Bulletin No. P1211 gives engineering data on selection and installation of thermocouples, protection wells, lead wire, and thermocouple and protection-well assemblies.

68 PYROMETERS—C J Tagliabue Mfg Co, Park and Nostrand Ave, Brooklyn 5, N. Y. 40-page catalog No. 1101H describes Tag Celectray pyrometers for recording, controlling and indicating temperatures.

MISCELLANEOUS

69 COMMUNICATION SYSTEM—Executone, Inc, 415 Lexington Ave, New York 17, N. Y. 4-page booklet includes a *Catalog-Survey Chart* with which the executive is able to analyze his communication requirements between departments and at same time obtain from Executone's engineering department a detailed proposal outlining a communication system planned to his requirements.

70 PRINTERS—Peck & Harvey, 4327 Addison St, Chicago, Ill. Leaflet gives operation and price list of B1 and B2 table-type continuous printers for blueprints and direct-process black-and-white prints.

71 INTERCOMMUNICATION SYSTEMS—Talk-A-Phone Mfg Co, 1219 W Van Buren St, Chicago, Ill. 8-page catalog No. 1944 presents fifteen models of intercommunication systems.

72 AIR TRANSPORT—Air Transport Assn of America, 230 Park Ave, New York 17, N. Y. 26-page booklet, fifth edition, contains passenger, air-mail, air-express data, etc, on airlines during first year of war, as compared with peacetime operations. Information is given in chart form.

73 AMERICAN STANDARDS' PRICE LIST—American Standards Assoc, 29 W 39th St, New York 18, N. Y. 24-page booklet gives prices of more than 600 standards, of which 64 have been approved or revised since the last price list was printed (April, 1943). Standards cover specifications for materials, test methods, dimensions, definitions of technical terms, procedures, etc. Standards approved by ASA represent agreement on part of maker, seller and user groups as to best current industrial practice.

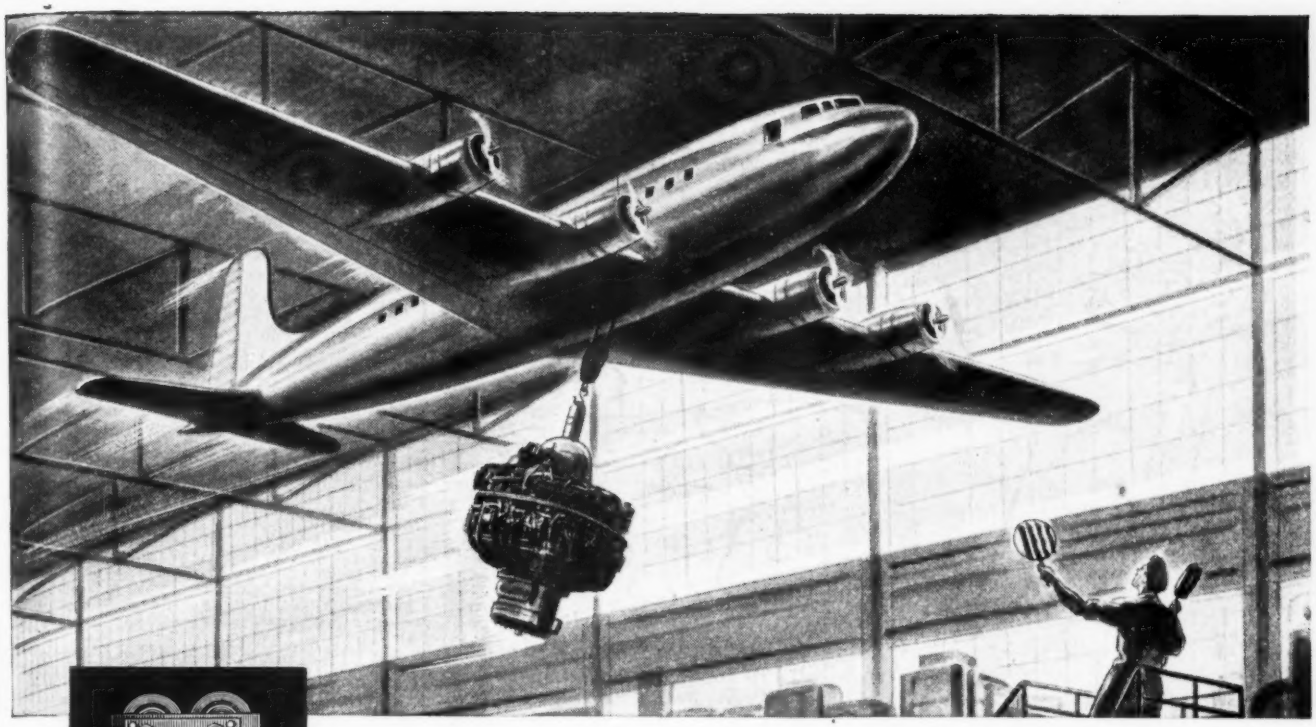
All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ REFERENCE BOOK—Preferred Utilities Mfg Corp, 1860 Broadway, New York 23, N. Y. 190-page memo and reference booklet contains data on various engineering subjects, together with world maps and lists of cities with their populations. Half of booklet has quadruled paper for notes and sketches. Book sent only to oil-burning trade.

PIPING, FITTINGS, VALVES AND SPECIALTIES

74 PIPING—Midwest Piping & Supply Co, St. Louis 4, Mo. 16-page bulletin No. 43-A, entitled *Simplified Method for Calculation of Pipe Wall Thickness*, simplifies essential data for the easy and rapid determination of pipe-wall thicknesses at various temperatures.

75 UNIONS—Clayton Mark & Co, Evanston, Ill. Leaflet describes forged-steel unions with either steel or bronze seats. Bronze seats are completely fused to the steel by a new method of brazing. Unit descriptions give psi for oil, gas and water.



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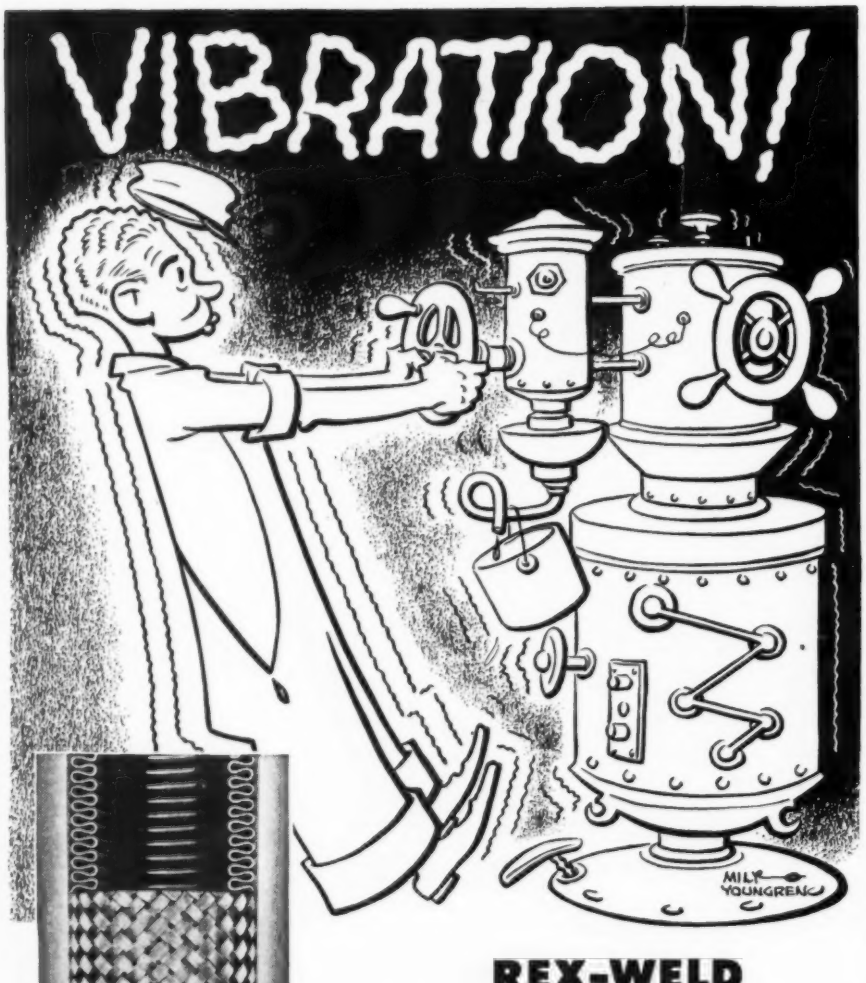

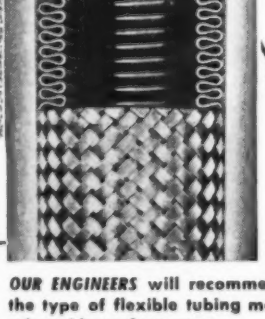

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OUR ENGINEERS **will recommend the type of flexible tubing most adaptable to these uses—**

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3. For handling searching liquids without seepage.
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6. For conducting liquids and gases to reciprocating parts.
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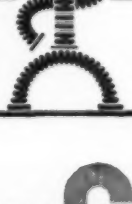
9. For correcting misalignment.



Flexible Metal Hose for Every Industrial Use

CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

76 CONDENSATE SYSTEM—Cochrane Corp, Philadelphia, Pa. 4-page booklet No. 3025 gives detailed specifications of the Cochrane-Becker high-pressure return system. Sketches on operation and installation are included.

77 VALVES—Jenkins Bros, 80 White St, New York 13, N. Y. Bulletin announces new line of Air-Furnace malleable-iron valves for 150 psi at 450 F, where severe conditions are encountered. Comparison chart on tensile strength, shock resistance, temperature limit, corrosion resistance and valve cost is included in pamphlet.

78 VALVE—Grove Regulator Co, 6529 Green St, Oakland 8, Calif. 4-page bulletin No. 400 covers combination pressure-reducing and automatic-shutoff valve for air and gas lines.

79 RELIEF VALVES—Cochrane Corp, 17th and Allegheny Ave, Philadelphia, Pa. 10-page publication No. 2870 gives applications and advantages of Multiport relief valves. Tables contain capacities and pressure rises, dimensions, weights and list prices.

80 BUTTERFLY VALVES—R-S Products Corp, Wayne Junction, Philadelphia 44, Pa. 36-page catalog No. 14-B describes complete line of butterfly valves for pressures from 15 to 900 psi. Booklet contains detailed specifications, applications and descriptions of new valves.

81 RUBBER-SLEEVE VALVE—Grove Regulator Co, 6547 Green St, Oakland 8, Calif. Bulletin No. 800, 20 pages, describes Flexflo remote-control valve for cold-fluid service. Cylindrical flexible tube over slotted pipe-like core operates by manual or automatic control of hydraulic balance on flexible tube. No overhead chains or electrical connections. Tight shutoff.

82 VALVES—Automatic Temperature Control Co, 34 E Logan St, Philadelphia 44, Pa. 4-page catalog No. A3 covers ATC line of high-speed motorized valves for *on-off* control of steam, air, oil, gas or chemical solutions. Construction and operating features are explained by charts.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ STRAIGHTENING AND BENDING PRESSES — Watson - Stillman Co, Roselle, N. J. 38-page bulletin No. 320-A covers straightening- and bending-press line. Pipe benders and shaft straighteners are included in equipment descriptions.

83 STOP VALVE—Grove Regulator Co, 6529 Green St, Oakland 8, Calif. 4-page bulletin No. 515 gives operating principle, rangeability, flexibility and application of Grove automatic stop valves.

84 PIPE-LINE FILTERS — Dollinger Corp, 11 Centre Pk, Rochester 4, N. Y. 8-page booklet describes pipeline filters as applied to air and gases. Photographs, tables and typical layouts are given.

85 EXPANSION JOINTS — Yarnall-Waring Co, Chestnut Hill, Philadelphia 18, Pa. 16-page bulletin No. EI-1909 describes Yarway Gun-Pakt and Gland-Pakt expansion joints. Bulletin also gives data on how to figure pipeline expansion and pipeline anchors. Prices, shipping weights, dimensions and typical installations of Yarway expansion joints are included.

86 INTERCONNECTOR—Industrial Interconnector Co, 2150 Niagara St, Buffalo 7, N. Y. 4-page bulletin introduces new Sure-Shift interconnector, which is a hydraulic-valving mechanism for delivering water from either of two inlets to a common outlet, without possibility of contamination.

87 TRAP—W H Nicholson & Co, 12 Oregon St, Wilkes Barre, Pa. Bulletin No. 341 discusses Model JR weight-operated trap for automatically draining water and oil from compressed-air intercoolers, aftercoolers, separators, receivers, etc.

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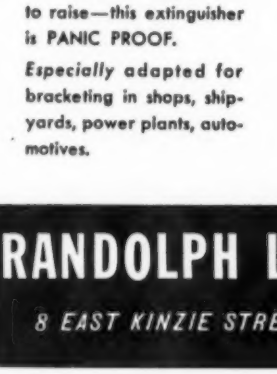

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Randolph "4" carbon dioxide is SAFE. Does not conduct electricity—will not damage food, equipment, or machinery. *Approved, labeled by Underwriters' Laboratories, Inc.*

Mobilize your fire protection with Randolph "4". For prompt delivery, phone your nearest supply house or write Randolph Laboratories—today.

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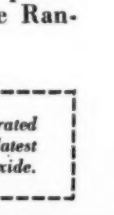


PRIME MOVERS AND ACCESSORIES

88 PISTON RINGS—Cooktite Ring Sales Co, 1737 Howard Ave, Chicago, Ill. 16-page bulletin, entitled 50 to 75% *Less Cylinder and Ring Wear*, points out cost of cylinder wear in diesel engines and shows how joints of proper ring design and material increases liner life. Bulletin also discusses other factors contributing to cylinder wear.

89 CARBON-SEAL RINGS—Pure Carbon Co, St. Marys, Pa. 8-page booklet deals with carbon-seal rings and their application to bellows-type shaft seals. Carbon-seal ring features are detailed with relation to specific uses. Drawings of seal designs are included, as well as particulars regarding adaptability of various seals to other applications.

90 TURBOSUPERCHARGER—General Electric Co, Schenectady, N. Y. 32-page bulletin No. GEB-132, entitled *They're Turbosupercharged*, describes turbosupercharger construction and points out how it differs from the geared supercharger. Turbosupercharger operation is explained in non-technical language.

PUMPS

91 PUMPS—Chain Belt Co, 1600 W Bruce St, Milwaukee, Wis. 20-page catalog gives information on mechanical parts and construction of the pump, how the pump operates and what it will do. Also included are specifications and capacity charts for pump selection.

92 CENTRIFUGAL PUMPS—Worthington Pump & Machinery Corp, Newark 2, N. J. 4-page bulletin No. W-321-B7C discusses Type DO open impeller balanced Monobloc centrifugal pumps. Rating tables and construction and dimension sketches are given.

93 CENTRIFUGAL PUMP—Worthington Pump & Machinery Corp., Newark, N. J. Bulletin No. W-321- B14B covers single-stage balanced Monobloc centrifugal pump, including typical pump sections and composite rating and dimension tables.

94 PUMPS—Yeomans Bros Co, 1433 Dayton St, Chicago, Ill. 32-page bulletin No. 6201 covers line of dry-pit sewage pumps. It includes selection tables, installation drawings and photographs and up-to-date specifications.

WATER TREATMENT

95 LIQUID FILTERS—Dollinger Corp, 11 Centre Pk, Rochester 4, N. Y. 8-page bulletin covers liquid filters for oils, water, chemicals, etc. Pressure-liquid filters and sump-liquid filters are described by photographs, diagrams and tables.

96 WATER SOFTENERS — Graver Tank & Mfg Co, East Chicago, Ind. 16-page bulletin covers manual, semi-automatic and full-automatic geolite water softeners. Equipment photographs, charts and plant-layout sketches are included.

97 SOFTENERS—Cochrane Corp, 17th St below Allegheny Ave, Philadelphia, Pa. 16-page booklet No. 4021 gives applications, operation, characteristics and advantages of carbite carbonaceous zeolite softeners.

98 CHLORINE AND pH CONTROL—W A Taylor & Co, 7300 York Rd, Baltimore 4, Md. 83-page handbook, entitled *Modern pH and Chlorine Control*, gives (1) a non-technical explanation of pH control and methods for making colorimetric determinations; (2) precautions to be observed; (3) discussion of pH and chlorine-control application to different fields; (4) technical discussion on pH control. Publication contains descriptions of Taylor slide comparators for general pH and chlorine control and for determination of phosphates, silica, total iron, etc, in boiler water.

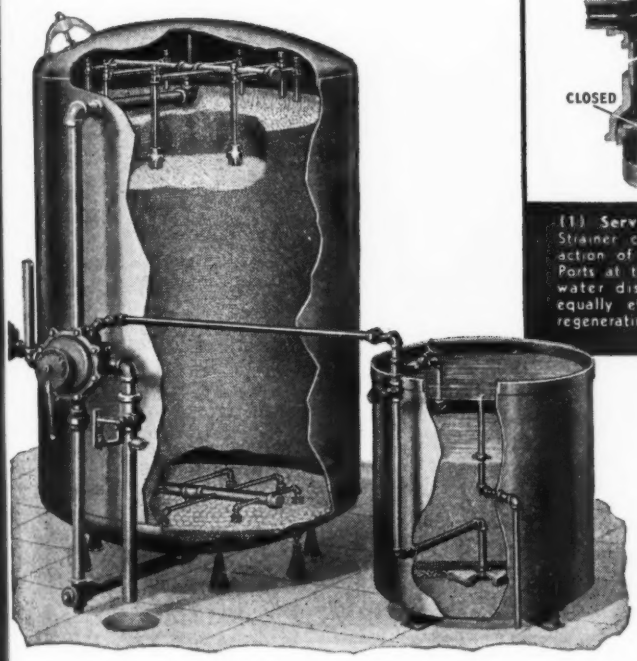
WELDING

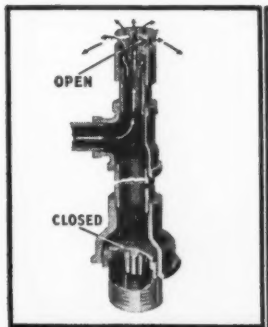
99 WELDING—Eutectic Welding Alloys Co, 40 Worth St, New York 13, N. Y. 36-page data book gives information on low-temperature welding for fabrication, salvaging and general maintenance. Chart simplifies rod selection and use.

44% MORE CAPACITY!

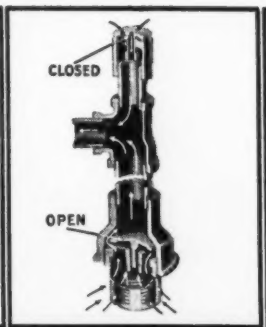
That's the remarkable record of the Improved Elgin "Double-Check" Water Softener

The improved "Double-Check" manifolds are shown in the cutaway view of the Elgin Softener below. Close-ups at right explain operation.

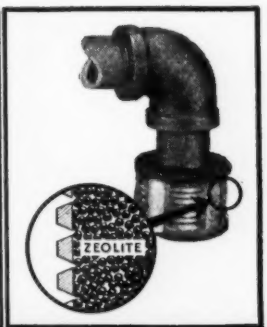




(1) **Service position.** Strainer closed off by action of lower check. Ports at top give even water distribution — equally effective when regenerating.



(2) **Backwashing.** Strainer now open. Greater part of wash water passes through it: balance through small ports in top. This flushes out foreign matter without zeolite loss.



(3) **Lower strainer nozzle.** Section through strainer shows shape of slots which prevent loss of zeolite when softening and gives free action when backwashing.

THE already well-established Elgin "Double Check" Water Softener has now been further improved to provide ever greater softening capacity and efficiency. Illustrated above is the improved "Double-Check" type manifold. It permits the use of a far deeper zeolite bed by preventing zeolite loss.

More zeolite naturally means more soft water output. The 44% increase in capacity headlined above is not the exceptional case, but is fully confirmed by a *long list of users* whose names are available to you.

Since the zeolite cannot escape, higher backwashing rates are possible with the "Double-Check" equipment. Better backwashing cleans the softener thoroughly and prevents packing and channelling. As a result, the brine reaches every grain of zeolite, giving better regeneration with less salt consumption.

If you are planning the installation of zeolite water softeners for power, process or general applications, don't overlook the added capacity and economy of this improved design.

ELGIN SOFTENER CORPORATION
130 North Grove Avenue, Elgin, Illinois

THE "DOUBLE-CHECK" ALONE—

- **Delivers up to 44% more soft water**
- **Prevents loss of zeolite**
- **Cuts salt consumption**
- **Permits more thorough backwashing**

("Double-Check" manifolds can be installed in any make softener)

STEP UP THE CAPACITY OF YOUR PRESENT WATER SOFTENER!

— the "Double-Check" manifold and Elgin high-capacity zeolite will do it.

The "Double-Check" manifold arrangement can be quickly installed in place of the ordinary manifold system of any make water softener to provide the above features. Immediate delivery can be made on any type zeolite required for refill purposes. Let us show you how economically these Elgin modernization steps can give you that much-needed extra capacity.

OTHER ELGIN PRODUCTS

- ▶ Boiler Water Conditioning Systems
- ▶ Deconcentrators
- ▶ Continuous Blowdown Systems
- ▶ Filters and Purifiers
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- ▶ Chemical Feeders
- ▶ Water Treating Chemicals
- ▶ Water Testing Equipment

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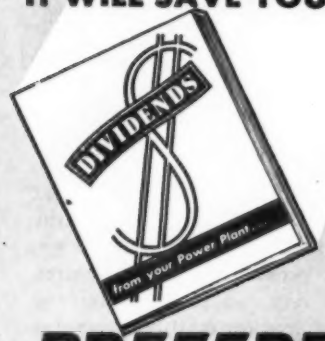
FOR THE MAN INTERESTED IN SAVING MONEY... AND WHO ISN'T?

For the price of a 3¢ stamp, Preferred Utilities Manufacturing Corporation offers an unusually informative booklet on cutting power plant costs. Written in non-technical style for the engineer to use with his executives who have long pondered over the "imagined" complexities of power generation. It is particularly timely today when management is so beset by the costs and scarcity of fuels. Covering a wide variety of economy effecting topics, it may well open the eyes of many an unsuspecting executive . . . unsuspecting in the sense that he does not realize the importance of the power plant and the power plant engineer.

THIS IS NOT A SALES BOOKLET, and contains no advertising matter of any form. It is published in enjoyable, easy-to-read fashion as a service to engineers, managing executives and owners of establishments where steam generation is used for power, heating or processing. It is applicable to any make of power plant or steam generating equipment.

SEND FOR THIS BOOKLET WITHOUT DELAY, IT WILL SAVE YOU MONEY IN MANY A WAY!



To receive this profitable 36-page booklet, prepared and edited by 10 of the leading engineers in the field of power generation, mail the coupon below and it will come to you free of charge and without obligation of any kind.

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PREFERRED UTILITIES MANUFACTURING CORPORATION
1860 Broadway, New York 23, N. Y.

Please send your free booklet on cutting power costs.
I understand your representative will not call.

Name.....

Company Name.....

Address..... P-3-44

100 ARC WELDING—Callite Tungsten Corp, Union City, N. J. 4-page bulletin No. 154 describes application of Callite tungsten electrodes for atomic hydrogen, helium and argon arc welding and gives complete data on tungsten electrodes available, their physical properties, dimensions and current range in amperes.

101 RESISTANCE WELDING—General Electric Co., Schenectady, N. Y. 46-page booklet No. GET-1170 consists of articles on the circuits and operation of electronic controls for resistance welding. Simplified circuit diagrams explain fundamentals of GE electronic controls for individual resistance welding processes and jobs. Electric accessories for resistance-welding processes are also included.

102 TORCH BRAZING—Handy & Harman, 82 Fulton St, New York 7, N. Y. Sheet contains instructions for torch brazing with silver alloys. Seven steps are given for strong, ductile, leak-tight joints.

103 WELDING—C E Phillips & Co, 2750 Poplar St, Detroit 8, Mich. 12-page booklet, entitled *Four Ways to Salvage, Reclaim and Conserve Iron Castings by Electric Arc Welding*, describes four electrodes for cast iron and explains characteristics and best welding procedures for each.

104 WELD-INSPECTION CHART—Lincoln Electric Co, Cleveland, Ohio. Chart gives actual specimens of various results obtained in making fillet and butt welds and describes appearance and characteristics of proper and improper weld beads, with a brief description of conditions under which each was made.

105 PIPE-THAWING EQUIPMENT—General Electric Co, Schenectady, N. Y. 4-page bulletin No. GEA-2059C discusses three different classes of pipe-thawing equipment. These three classes are air-cooled transformers, distribution transformers and engine-driven arc-welding sets.

Metals Forecast Changes

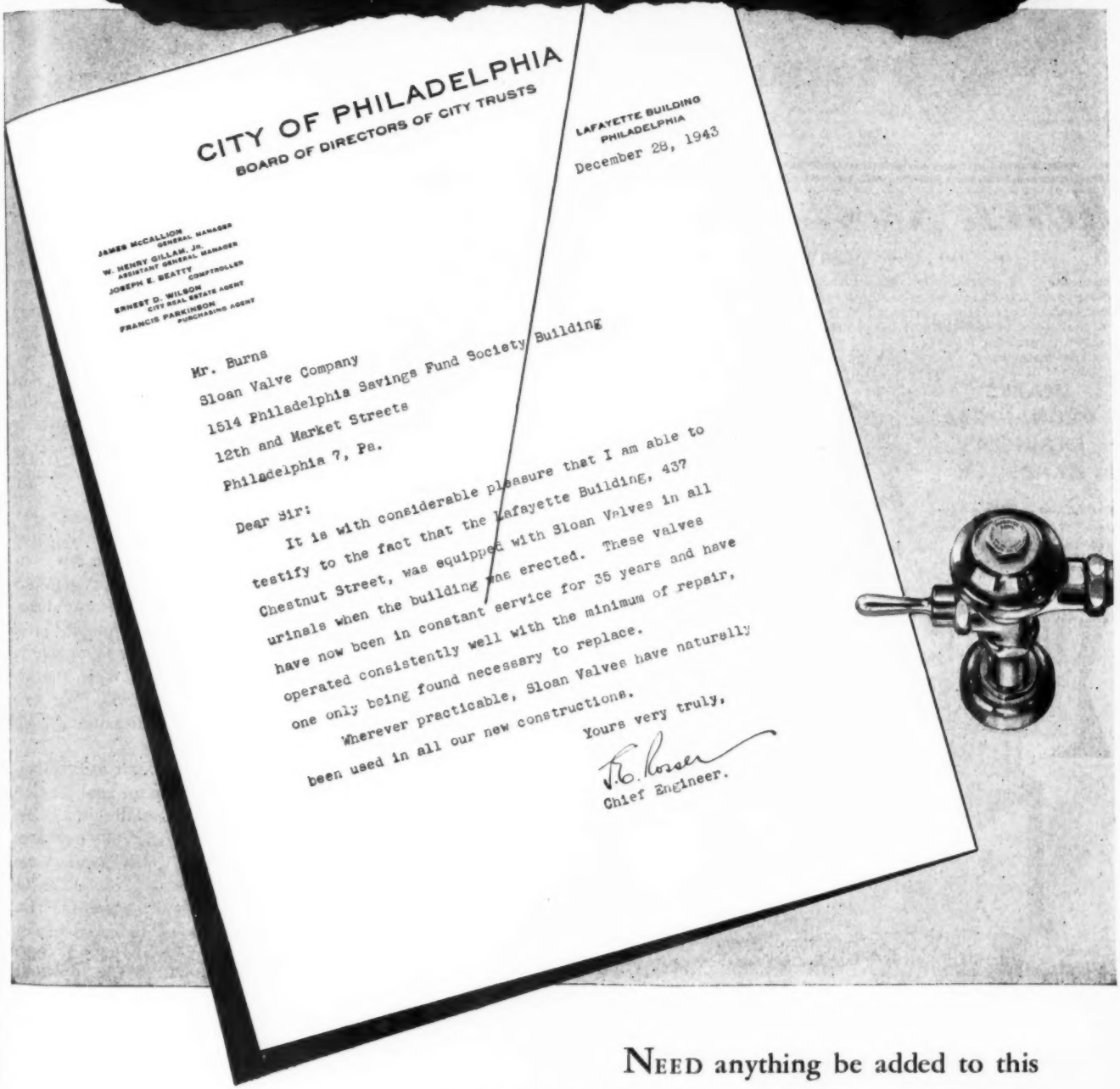
(*Continued from page 87*)

million cycles. High frequency heating (instead of surface plates) produces no overheating at the outside layer. To make dielectric heating a success, the bonding material should have a high power factor.

Of increasing importance will be metals that withstand high temperatures without corroding or flowing like molasses under stress. In looking over my college books that date back not too far, 730 F was the top temperature for turbine blading. Today, we are thinking of 1500 F for gas turbines. These alloys are one of the keystones that will determine whether or not gas turbines become important. Known before the turn of the century, low efficiency prevented their extensive use. At 1500 F their thermal efficiency becomes high enough to warrant consideration. You who have to plan many years ahead can ill afford not to watch closely development and adaptation of new materials.

From a paper presented by R G Bergvall, Westinghouse Elec & Mfg Co, before the AIEE, Roanoke, Va.

"... in constant service for 35 years .... with minimum of repair ...."



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PHILADELPHIA

December 28, 1943

Mr. Burns
Sloan Valve Company
1514 Philadelphia Savings Fund Society Building
12th and Market Streets
Philadelphia 7, Pa.

Dear Sir:

It is with considerable pleasure that I am able to testify to the fact that the Lafayette Building, 437 Chestnut Street, was equipped with Sloan Valves in all urinals when the building was erected. These valves have now been in constant service for 35 years and have operated consistently well with the minimum of repair, one only being found necessary to replace.

Wherever practicable, Sloan Valves have naturally been used in all our new constructions.

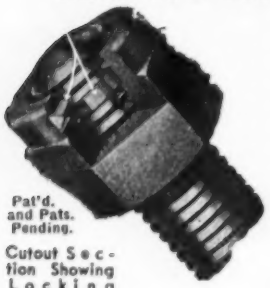
Yours very truly,

F. C. Rosen
Chief Engineer.

NEED anything be added to this straightforward testimony of Sloan Flush Valve's enduring efficiency? Yes... just one fact: *there are more Sloan Flush Valves sold than all other makes combined.*

SLOAN VALVE COMPANY
4300 WEST LAKE STREET • CHICAGO, ILLINOIS

JUST TIGHTEN IT AND IT'S THERE TO STAY



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Cutout Section Showing Locking Ring in Place

UNSHAKO
Reg. U. S. Pat. Off.
Self-Locking Nut

Designed on brake band principle, a built-in self-energizing locking ring keeps the nut from unwinding under vibration. Entirely self-contained, the "Unshako" is applied and removed like ordinary nut. Can be used again and again. Further information gladly sent upon request.

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OVER 40 YEARS IN BUSINESS

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Here are 2276 pages of data constantly needed by engineers, machinists, designers, draftsmen, plant and shop employees in every branch of mechanical engineering. Arranged in handy reference form are answers to thousands of questions of every type—covering theory, standards and practice—compiled by experts in many lines.

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This NON-CLOGGING PUMP assures *UNINTERRUPTED* flow ...at Lower Maintenance Cost

Economy Vertical Non-Clogging Pump. Capacities 100 to 1500 G.P.M. Heads to 200 ft.

Helping Industry maintain continuous operations by preventing costly clogs *before they can occur*, is the special duty of Economy "Stand Up" Open Shaft Pumps. These units have generous sized clear waterways for handling unscreened sewage, miscellaneous pulps or trash without clogging. And, *uninterrupted* flow means greater gallonage per man-hour when man-power is limited. A few of the typical applications of these units are:

- Sewage Disposal
- Paper Pulps
- Underpass Drainage
- Sludge Removal
- Food Industries
- Reduction Plants

Motor is mounted in a yoke directly above the pump and *flexibly coupled* to the pump. The pump has its own heavy duty bearings and separate shaft. Perfect alignment is always assured. It will pay you to write for Economy's New Pump Data Book—free to Plant Executives and Engineers requesting their copy on company letterhead.

ECONOMY PUMPS, Inc.
HAMILTON, OHIO, U.S.A.

Power Lines

(*Continued from page* 130)

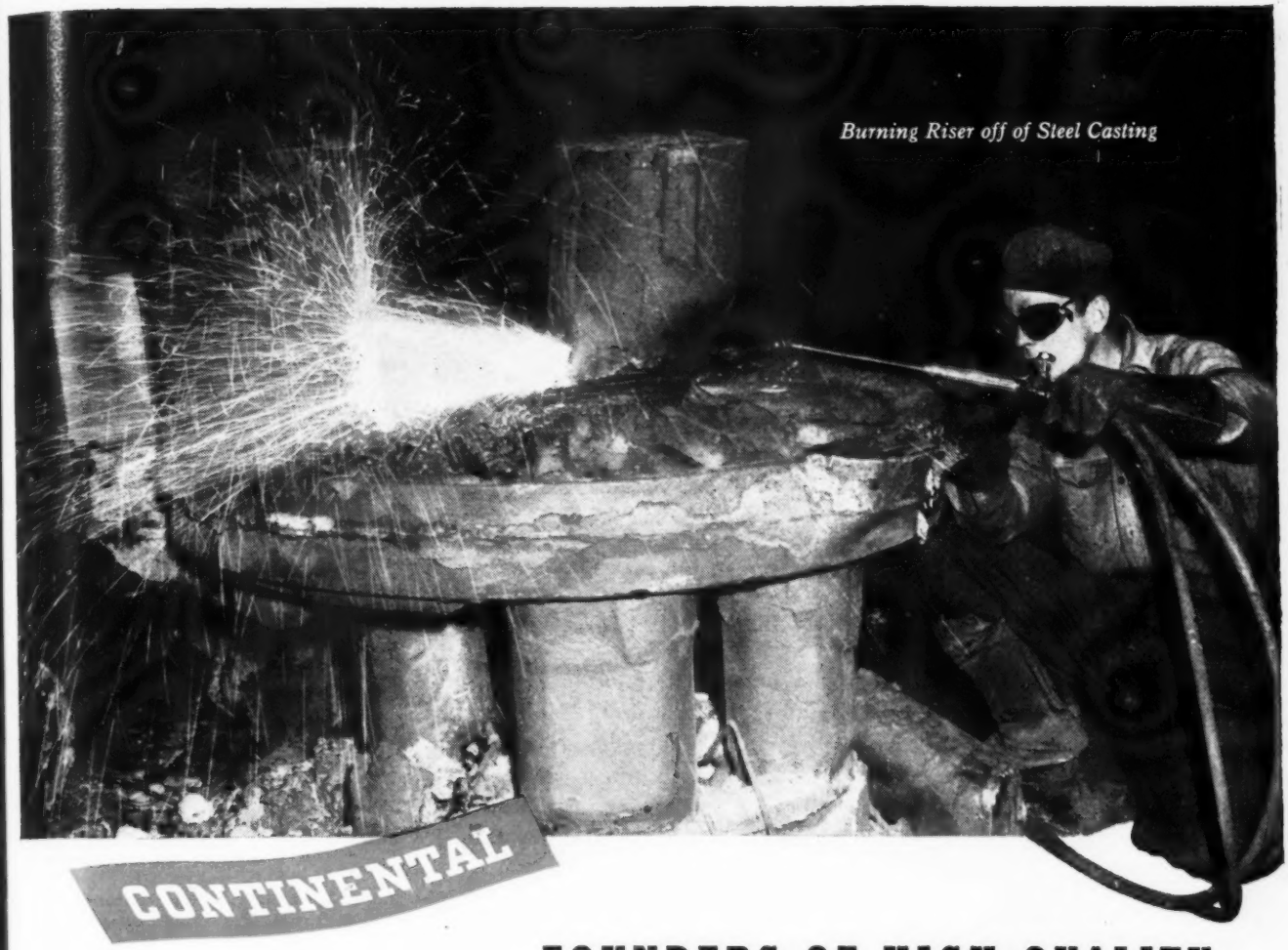
public utilities in the eleven far western states in 1920, and is nearly as much as that of all plants in the U. S. when Federal reclamation was established in 1902.

Coal producers and commercial consumers can now obtain a report on the characteristics of certain solid fuels, describing carbonizing properties and petrographic composition of coal from the Thick Freeport bed of Pa., and the effect of blending this with coal from the Pocahontas No. 3 and 4 beds. Send to the Supt of Documents, U. S. Government Printing Office, Washington 25, D. C., if you wish a copy of this Bureau of Mines Technical Paper 655—*Carbonizing Properties and Petrographic Composition of Thick Freeport Bed Coal from Harmar Mine, Harmarville, Allegheny County, Pa., and the Effect of Blending This Coal with Pocahontas No. 3 and No. 4 Bed Coals. 10c a copy.*

Bituminous coal production set a new high in 1943 when production totaled 589,000,000 tons, but stockpiles were drawn down by 31,000,000 tons, according to Solid Fuels Administrator Ickes. He considers the figures abundant proof that the coal industry "was unable to produce enough fuel to meet the nation's requirements in 1943. We were saved from possible disaster by our stockpiles."

Use of oil by East Coast utilities was principally responsible for coal for electric-power generation totaling 6.2% less in Nov, 1943, (when 6,863,000 tons were used) than in Oct. Daily average use dropped 3.1% during Nov (228,767 tons used) from the Oct average. On Dec. 1, stockpiles of industry totaled 15,838,000 tons, a drop of 8% from Nov. 1.

A century of progress in engine building is depicted in a new industrial film, *Continuous Performance*, just released by Cooper-Bessemer Corp. It traces the development of the firm's engine production from its humble beginning 110 years ago to its present position as one of the foremost producers of diesel and gas engines, compressors and foundry castings. The picture is scheduled for extensive showings throughout the country so that Government officials, engineers, students and others may obtain a better understanding of the application of the company's engines for the various power requirements.



FOUNDERS OF HIGH QUALITY

STEEL CASTINGS

This is 1944! What can we do to make it the Victory Year? The goal . Victory. The place . . Europe. The time . . this year. The responsibility . . Ours.

Let's All Back The Attack!

BUY WAR BONDS

Continental's leadership in the production of Carbon and Alloy Steel Castings from the most simplified to the most intricate is the result of Continental's skill and experience gained through years of pioneering research in the manufacture of high quality steel castings of all types.

At Continental today one finds the most modern equipment, special machinery and heat treating facilities available anywhere in the industry. Also there are four strategically located plants to meet your specific requirements.

For Steel Castings or special heavy industrial equipment, specify Continental and be assured of the finest. *Continental Roll & Steel Foundry Company, Chicago • Pittsburgh.*

Continental Roll & Steel Foundry Company

Specializing in carbon and alloy steel castings for the following: Power, Shipbuilding, Railroad, Machinery, Metal Engineering, Military, Naval and Ordnance. Manufacturers of Rolls, Rolling Mill Equipment and Special Machinery

Order of the day:

CONSERVE FUEL

HENSZEY CONTINUOUS BLOWDOWN

Permits full production with great savings of fuel!

Our government's emphasis on the conservation of fuel calls attention to the saving made possible by the installation of Henszey Continuous Blowdown. The Henszey system keeps boiler water concentration within safe margins—preventing foaming, priming, and the formation of sludge and scale with proper chemical treatment. Remember, a clean boiler—requiring less fuel to carry the power load.

The Henszey system accomplishes this without the heat loss of ordinary intermittent blowdown—a big item in the conservation of those vital B. T. U.s.

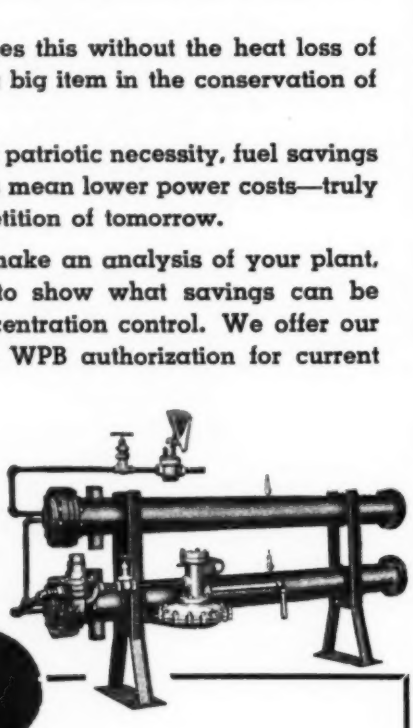
While fuel conservation is now a patriotic necessity, fuel savings and lower manpower requirements mean lower power costs—truly important to consider in the competition of tomorrow.

Henszey engineers will gladly make an analysis of your plant, presenting practical suggestions to show what savings can be made by proper boiler water concentration control. We offer our assistance to help you apply for WPB authorization for current installations.

HENSZEY CO.

Dept. D3

Watertown, Wis.



HENSZEY

CONTINUOUS BLOWDOWN

Flow Indicators • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

CURRENT ARMY-NAVY AWARDS

Army-Navy E pennants now fly over:
C H Wheeler Mfg Co, Dec 17.
Bureau of Mines, two helium plants.
Foote Bros Gear & Machine Corp, Dec 30.

White stars (Army-Navy E renewals) have been awarded to:
Maxim Silencer Co, 1 star, Dec 9.
Philco Corp, Simplex radio div, 2 stars.
Babcock & Wilcox Co, Augusta, Ga., works, refractories div, 2 stars, and Barberton plant, 3 stars.
DeLaval Steam Turbine Co, 3 stars.

Gold star (U. S. Maritime Commission renewal) is added to M pennant of *Homestead Valve Mfg Co.*

OBITUARIES

A S Workman, manager, Baltimore office, Frick Co, died Jan 27 of a heart attack.

Jas J Duncan, 54, chief engineer, Federal Bldg, Boston, died on Jan 3.

Abraham Wood, 73, stationary engineer, Emergency Hospital, Buffalo, died Jan 1.

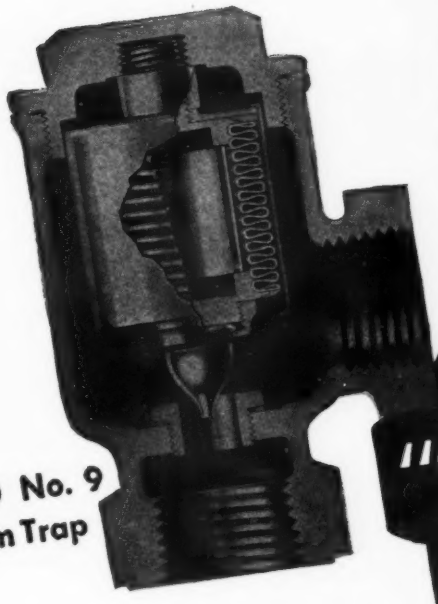
Frederick O Schultz, stationary engineer, Syracuse, N. Y., YMCA, died recently.

Silas J Steves, 85, former stationary engineer, Solvay Process Co, Syracuse, N. Y., died recently.

Office of War Utilities has approved installation of two small generators in industrial plants, in line with its policy of correcting local situations wherever possible. A 1000-kw steam unit will be installed in the Rochester, N. Y., plant of Gleason Works, and a 4000-kw steam unit in the West Point, Va., plant of the Chesapeake Corp.

Machinery travels by air, according to a survey which shows that airborne express is headed by machinery, electrical parts and hardware. In fact, it forms 27% of the total weight carried.

Today, emergency replacements of injured parts are carried by airplane to power plants, factories and mines. Importance of such shipments is illustrated by an accident to mining machinery in a Fargo, N. Dak., plant. Late one Sat-



SARCO No. 9
Steam Trap

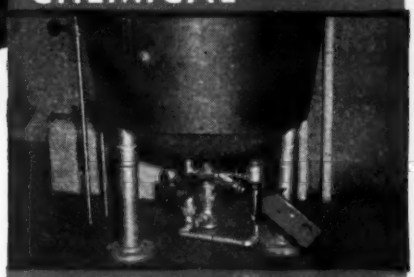
THE STEAM "SPARK PLUG" of the Heat Using Industries

When heat is a considerable part of the cost of production and when lack of heat slows up the process, the steam engineer is caught between two millstones. The departments yell for "more heat", and the management calls for ever lower production costs.

Here's the steam trap that will solve the dilemma — the Sarco No. 9 thermostatic steam trap which extracts the last bit of available heat before it lets go and which lets go often enough to keep live steam in the coils at all times.

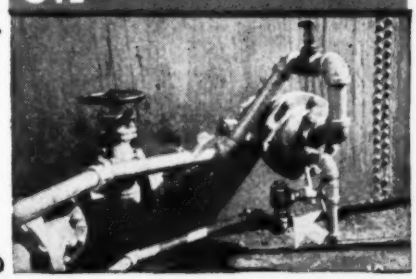
FOOD

CHEMICAL



TEXTILE

OIL



A Trap On Every Coil. Don't expect the impossible — even from a Sarco No. 9 — for each steam coil in a battery should have a separate trap, otherwise the heavily loaded coils will slow down the entire battery. Individual trapping is not expensive with the No. 9. It is small, light in weight, and is easily connected to the line.

This trap will not stick, freeze, or air bind, and will work satisfactorily at all pressures within its range, without changing seats — a great help where your pressures vary.

As An Automatic Air Vent. Sarco No. 9 s are used by the thousands to remove air from all kinds of steam equipment lines. See Catalog No. 250.

9

SARCO COMPANY, INC. 475 FIFTH AVENUE NEW YORK 17, N. Y.

SARCO Saves Steam

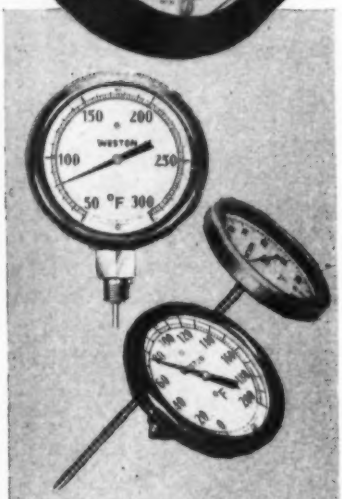
Represented in Principal Cities

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

WORLD'S LARGEST BUTADIENE PLANT

USES **WESTON**

all-metal thermometers



WESTON All-Metal Temperature Gauges are available in sizes and types for most industrial needs . . . as well as in laboratory models with full scale accuracy within ½ of 1%.

Deep in the heart of Texas is this new giant plant whose production dwarfs all others in the processing of Butadiene. And in this plant, too, WESTON all-metal temperature gauges are used at checking points because of their legible, gauge-type scales . . . their 1% full-scale accuracy . . . and their simplified all-metal construction which assures *long-term* accuracy, and safeguards against damage from vibration, over-ranging or mechanical abuse.

Literature describing WESTON temperature gauges, which employ no gases, liquids or fragile elements, gladly sent on request. Weston Electrical Instrument Corporation, 679 Frelinghuysen Ave., Newark 5, N. J.

WESTON *All Metal* **TEMPERATURE GAUGES**

urday afternoon a vital part broke, throwing out a large force of workmen. A new part, ordered by phone from a Bridgeport, Conn., firm arrived late Sunday and by the opening hour Monday morning the plant was ready for work.

Heaviest air shipment of the year was a shaft weighing 2200 lb, which was flown from the U. S. to South America.

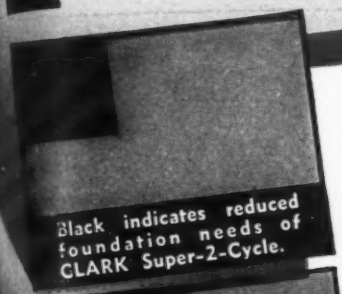
Midwest Power Conference, arranged by Illinois Institute of Technology, will be held April 13 and 14, at the Palmer House, Chicago. Featuring the theme, *Power Brings Victory,* this 7th annual meeting will emphasize both war and postwar power problems. The tentative program, which already includes 20 topics, will revolve around the following nine sessions: opening general meeting, three electrical meetings, power-plant practice, industrial power plants, plant maintenance, fuels and diesel power. Keynote speaker, Alex D Bailey, asst to vice-pres, Commonwealth Edison Co, Chicago, will speak on "Postwar Planning of the Nation's Power Supply." J A Krug, director, office of war utilities, WPB, Washington, D. C., will be the featured speaker at the All-Engineers' Dinner. Approximately 25 nationally known power authorities will appear on the program.

Natl Assn of Purchasing Agents, 11 Park Place, New York City, has issued forms, available on request, for collecting information in **selecting coal for steam-boiler plants.** Forms include all boiler-plant items bearing on this subject, and result from an extensive study by the assn's coal comm. Most items have been used for selecting coal, but this is believed to be the first standard arrangement that can be used by combustion engineer and coal buyer, mak-

The more you GIVE
—the more will LIVE

1944 RED CROSS WAR FUND

2-CYCLE *has* LOWEST INSTALLATION COST



Black indicates reduced foundation needs of CLARK Super-2-Cycle.

Black indicates reduced floor space for CLARK Super-2-Cycle.

CLARK "Angles" are housed in much narrower and smaller buildings.

More Compact for Power Delivered!

2-cycle design, as perfected in the CLARK "Angle" Compressor, has tremendously reduced installation cost per horsepower, for these basic reasons:

1. 2-cycle design eliminates the "waste stroke" of 4-cycle operation . . doubles the power per cylinder. This means maximum compactness per horsepower.

2. The vertical power cylinder further achieves compactness. Results: Shipment almost completely assembled . . smaller foundations . . smaller buildings . . minimum length of piping.

The CLARK 2-cycle offers greater fuel economy, less wear, smoother operation, fewer man hours, simpler construction. Investigate fully.

CLARK BROS. CO., INC. - OLEAN, N. Y.

Export Offices: 30 Rockefeller Plaza, New York. Domestic Sales Offices and Warehouses: Tulsa, Okla.; Houston, Texas; Chicago, Ill. (122 S. Michigan Ave.); Boston, Mass. (131 Clarendon St.); Huntington Park, Calif. (5715 Bicket St.) Foreign Offices: 72 Turnmill St., E. C. 1, London; Avda Roque Saenz Pena 832, Buenos Aires.

AFFILIATED COMPANIES

Dresser Mfg. Co., Bradford, Pa.; Pacific Pump Works, Huntington Park, Calif.; Bryant Heater Company, Cleveland, Ohio.

CLARK

Super-2-Cycle

PATCH FLOORS

. . . while Traffic Rolls

Here's a new, fast way to patch broken concrete without having to close off the area. Use durable INSTANT-USE . . . a tough, plastic material which you simply shovel into hole—tamp—and run traffic over immediately. NO WAITING. Bonds tight to old concrete. Makes smooth, solid, heavy-duty patch. Withstands extreme loads. Keep a drum on hand for emergencies. Immediate shipment.

A FLEXROCK PRODUCT

Request Descriptive Folder . . . and Details of

FREE TRIAL OFFER

INSTANT-USE

FLEXROCK Co.

3677 Filbert St., Philadelphia 4, Pa.

Please send me complete INSTANT-USE information . . . details of FREE TRIAL OFFER—no obligation.

Name .....

Company .....

Address .....

IMO *Reliability* IN NAVAL SERVICE

The reliability of IMO "lube" and fuel oil service pumps is typified by their trouble-free performance on a United States Destroyer reported to us by the Navy as having steamed over 84,000 miles on convoy duty during the past year, often cruising as much as 28 days per month without time for normal upkeep and overhaul.

Ask for Catalog I-115

***IMO* PUMP DIVISION**

of the De Laval Steam Turbine Company

Trenton 2, New Jersey

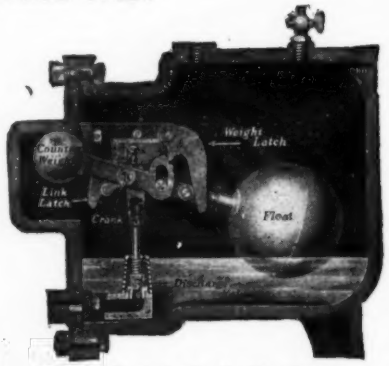
NICHOLSON TRAPS

↑ *UP Production* BECAUSE THEY

DOWN Trouble ↓

Many reports show that installations of Nicholson Traps have stepped up production of heated units as much as 30%. A size and type for every need.

Shown above are Types A (left) and C, two of five widely used Nicholson Thermostatic Industrial Traps; sizes ¼" to 2" for pressures to 225 lbs. All are proof against air-binding, freezing, dribbling and water-logging. Enormous water and air discharging capacity.



NICHOLSON

WEIGHT-OPERATED STEAM TRAP

A large-capacity trap for pressures to 1500 lbs. at 1000 degree maximum temperature. Positive automatic intermittent action. Quick opening and closing valve. Water-sealed discharge. Catalog No. 941 also shows Nicholson Piston-Operated and Compressed Air Traps.

Write for Trap Catalog 941. See our Catalog in Sweet's.

Traps • Valves Steam Specialties

W. H. NICHOLSON & CO.

125 Oregon St. Wilkes-Barre, Pa.

ing it possible for all boiler plants to be surveyed for these characteristics. Forms 1 and 2 contain information that changes only when equipment does and need be filled in only once for any equipment. Form 3 should be filled in at least once a year. Form 4 is active, to be filled in often, especially when changing coals. Form 5 simplifies reporting a coal trial.

E Russell Bassett has assumed his duties as manager of sales in central Pa., for **The McClave Co** (stokers and grates) with his headquarters in Allentown. **Electric Storage Battery Co** has assigned to **Roland Whitehurst** the title of sales manager for Exide. **Machlett Laboratories** announce the appointment of **Henry J Hoffman** as sales manager, power tube div, as well as administrative asst to Miles Pennybacker, v-p. **Blackmer Pump Co** transfers **Ford Brown** to Minneapolis, in charge of pump and accessory sales in that territory.

Philadelphia Gear Works announces that **James N Morrell** is sales manager, limitorque valve control div, and **Thos V Withington** asst sales manager. **Vincent K Alexander** is sales manager of **Manheim Mfg and Belting Co** (adjustable V-belt). **R A Maxwell** is in charge of all tire sales except airplane in the combined automotive, aviation and Government sales div of **The B F Goodrich Co. H B Lilley** has been promoted by the steel and tube div, **Timken Roller Bearing Co,** to be sales development engineer, specializing in application of mechanical tubing to machine tool products, etc. **Ray T Jenkins** heads the new Houston Tex. div of **The Marley Co** (cooling towers and spray nozzles).

Eshelman & Potter (power engrg) will represent **The Edward Valve & Mfg Co** in southeastern U. S. **Thos MacLachlan** has been named general manager, N. Y. and export office of **H K Porter Co,** for locomotives, process equipment and pumps. **Enterprise Engine & Foundry Co** announces that **E H Davis** is manager of their new New York office, headquarters for Governmental and commercial activities on the Atlantic seaboard. **Thompson-Hayward Chemical Co,** (16 midwest cities) will be exclusive representatives on **Griffin's Hytemp Protective Coating** for all the territory their organization covers.

Graham Transmissions (variable speed drives) announces appointment of five sales engrg organizations as representatives in their respective territories:

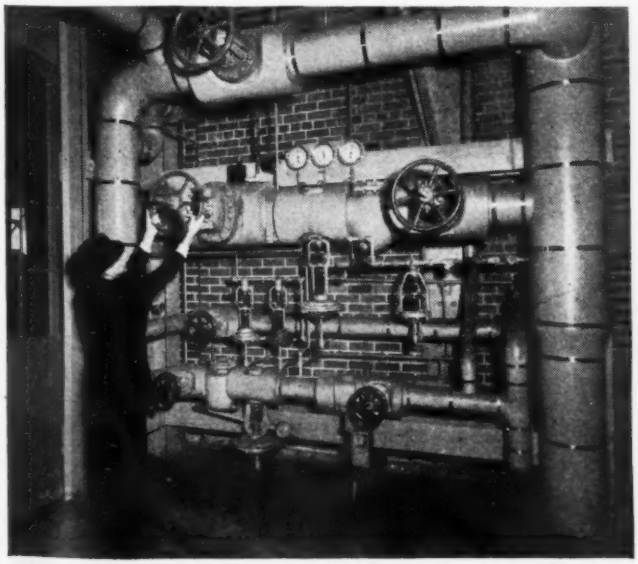
TO REDUCE DOWNTIME LOOK TO YOUR CONTROLS

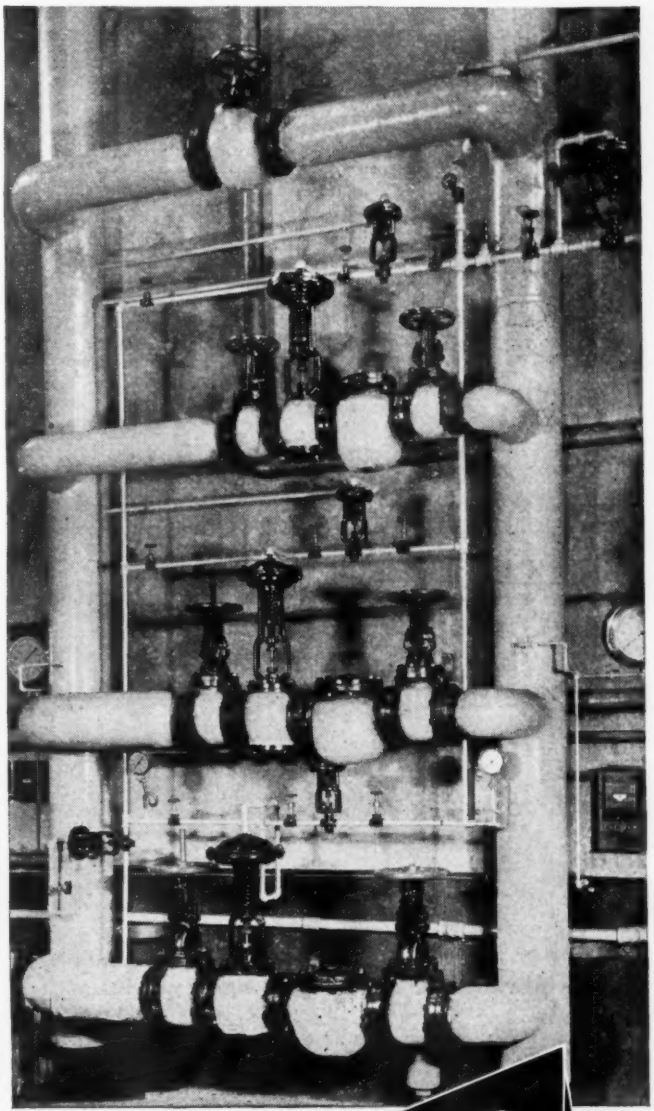
You're heading for trouble when maintenance costs begin to run high

MAKE SURE that controls are not the weak link in an otherwise efficient production set-up. Avoid the possibility of breakdown, by early replacement of controls that require excessive maintenance attention.

For *unfailing* regulation of pressure, temperature and flow, you can depend on McAlear Controls. Because every McAlear Control is individually developed for one job—and one set of operating conditions—precision engineered, metallurgically and mechanically, for long, trouble-free service.

One by one, as industry has conceived new processes, McAlear has developed advanced instruments for their control requirements. If *you* have a control problem, call on McAlear engineers. Draw on their fund of experience and readiness to help you. For informative bulletins and catalog, write McAlear Manufacturing Company, 1913 S. Western Avenue, Chicago 8.





Typical installations of McAlear pressure regulators used to maintain constant reduced steam pressures from power plants to heating service in large Government Housing Projects.

AVAILABLE SOON • AN IMPROVED DIAPHRAGM VALVE. New materials and radically improved design provide positive freedom from difficulties formerly encountered with diaphragm type valves. Unrestricted flow to full capacity of pipe line. Long-life, leak-proof shut-off surfaces. Completely dependable in service with highly corrosive fluids. Vastly superior where solids are held in suspension.

DEPEND ON McALEAR AND YOU CAN DEPEND ON YOUR INSTALLATION

McALEAR
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
controls
for STEAM, WATER, AIR, OIL—GAS

BUILD UP YOUR COAL RESERVE

the Economical SAUERMAN Way

Pictured above is a Sauerman Scraper System operating a 10 cu. yd. Crescent on a storage area semi-circular in shape and 400 ft. in radius. This machine handles an average of 400-tons an hour, either storing or reclaiming.

Sauerman Features:

- Low-cost equipment
- One man operation
- Greater safety
- Upkeep simple
- Fits any space

WRITE FOR CATALOG

With a Sauerman Scraper you can store a maximum tonnage of coal in a given space and the entire cost will be only a couple of cents per ton stored and reclaimed.

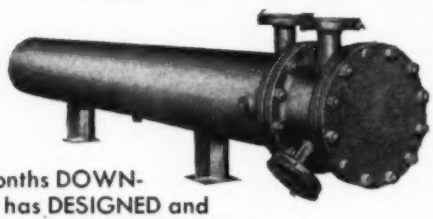
A Sauerman scraper layers the coal into the pile, avoiding segregation, and thus builds a high pile that is entirely homogeneous. Chances for deterioration and spontaneous combustion are reduced to a minimum.

There is a size and type of Sauerman machine for any coal storage project, large or small. Typical layouts of every size are illustrated and explained in our catalog.

SAUERMAN BROS., INC.

562 S. CLINTON ST. CHICAGO 7, ILL.

Heat Exchanger... "KnowHow"



In recent months DOWNINGTOWN has DESIGNED and BUILT units for the following unusual duties, as well as hundreds of heat exchangers, oil coolers, etc. for simpler applications:

Cooling complex mixed gases with water. Condensing organic vapors (alcohols, solvents) with water. Boiling organic vapors (alcohols, solvents) with steam. Cooling methyl alcohol with boiling Freon. Cooling complex mixed gases with boiling ammonia. Cooling diesel jacket water with crude oil. Write for details and literature.

DOWNINGTOWN IRON WORKS
DOWNINGTOWN, PA.
HEAT EXCHANGERS

Frank Campbell Coe, Philadelphia, Pa.; **John B Foley, Jr, Co,** Syracuse, N. Y.; **Paul M Kline,** Cleveland, O.; **Bruce W Rogers,** Akron, O.; **D W Smith,** New York City. **Kieley & Mueller** (automatic pressure and level control valves and equipment) appoint **F L Murdock Co** as sales representatives for Oklahoma and **Daniel Orifice Fitting Co** for Texas and Louisiana. **Paul Reinking** now represents **Belmont Packing & Rubber Co,** as service engineer, making his headquarters in Dallas, Texas, and covering the south eastern and south central territories.

Edison Electric Institute announce that they have set April 3 to 5 for their eleventh Annual Commercial Meetings to be held at the Edgewater Beach Hotel, Chicago. All sessions are open to the electrical industry concerned with **loadbuilding problems** of the electric utility companies.

Vannevar Bush, president, Carnegie Institution and director, office of scientific research and development, Office of Emergency Management, has been awarded the **1943 Edison Medal of the AIEE** "for his contribution to the advancement of electrical engineering,

particularly through development of new applications of mathematics to engineering problems, and for his eminent service to the nation in guiding the war research program."

Westinghouse Elec & Mfg Co announce that: **Herbert L Rawlins** is mgr, protective devices, engrg dept, and **A W Hill,** design engineer, is mgr, power circuit breaker engrg. **Wm J Massey** becomes gen lamp sales mgr with headquarters at Bloomfield, N. J. **Leon R Ludwig,** formerly head, circuit breaker and protective devices, has been named mgr, motor div. Holder of more than a score of patents, Mr Ludwig worked with Dr Jos Slepian to develop the ignitron, a power tube that converts ac into dc. **Harry H Chapman** is mgr, transportation dept, in Pittsburgh, following a

SAVES TIME
FOR THE PIPING DESIGNER

Revised and Enlarged Edition

Simple and Easy to Use

Simplified Method for

CALCULATION OF PIPE WALL THICKNESS

for Various Pressures and Temperatures based on A.S.T.M. and A.P.I. Specifications and the A.S.A. Code for Pressure Piping

BULLETIN 43-A
Copyright 1943

Originated and Developed by Engineering Department

MIDWEST PIPING & SUPPLY CO., INC.
St. Louis 4, Mo., U.S.A.

This bulletin will enable you to determine quickly and easily the required pipe wall thicknesses for commercial pressure and temperature conditions. All you do is select a factor from a table, divide it into the working pressure and then refer the quotient to a chart. You have no substitution in formulae . . . no extensive calculations . . . no reference to codes or specifications.

This bulletin will gladly be sent to anyone interested who requests it upon a business letterhead. Simply mention Bulletin 43-A and address the main office at St. Louis, Missouri.

MIDWEST PIPING & SUPPLY CO., INC.
Main Office: 1450 South Second St., St. Louis 4, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles
Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Bldg.

PIPING FABRICATORS AND MANUFACTURERS OF PIPE WELDING FITTINGS

The YARNS that make G-T PACKINGS service-resistant and long wearing

THIS IS THE **5th** of a series explaining why G-T PACKINGS give better service.

8 REASONS for the Superiority of G-T Packings

1. SIMPLE LINE . . . makes correct selection easy
2. COMPLETE LINE . . . an exactly suitable type for every service.
3. SELF LUBRICATING . . . each individual strand saturated with lubricant
4. SPECIAL LUBRICANTS . . . lubricant for each service specially compounded in our own plant
5. SELECTED YARNS . . . provide tensile strength and resist high temperature
6. CONSTRUCTION . . . assures maximum endurance, longest life, lowest friction
7. EXPERIENCE . . . 80 years of manufacturing experience
8. PERFORMANCE . . . proven in thousands of plants of every type

Only the finest obtainable and most suitable materials are used in G-T Packings.

For PALMETTO and other G-T Packings, high quality, long-fibre, heat-resistant, Canadian asbestos is carefully selected and processed in *one of our own* large plants. For SUPER-CUTNO acid-resistant Packing, only genuine South-African Blue Asbestos is used because it does not contain water. PALCO Packing, for cold water, is made of selected long-line cotton spun into a soft, lubricant-absorbing roving which is superior to flax and other materials.

These are instances of how each G-T Packing is specially prepared for long life in the precise range of services for which it is designed. To assure lowest year-round packing costs and best service, insist on G-T Packings . . . obtainable from your dealer.

GREENE, TWEED & CO.
Bronx Blvd. at 238 St., New York 66, N.Y.
PLANTS: New York, N. Y. and North Wales, Pa.

PALMETTO *for steam, hot water, air.* PALCO *for water.* PELRO *for oils.* CUTNO *for alkalis.* SUPERCUTNO *for acids.* KLERO *for foods, etc.* PALMETTO SUPERSHEAT PACKINGS

G-T *self-lubricating* **PACKINGS**

reorganization of the central-station and transportation dept, in which the latter was established as a separate industry dept. **Lee W Ralston,** formerly with Calif. state educ. dept, is supervisor, industrial relations, mfg and repair dept. **Allyn R Heck,** Cleveland merchandise mgr, Electric Supply Co, is now regional coordinator, electric-appliance div. **E V Wetmore** is appointed N Eng. district mgr, Electric Supply Co.

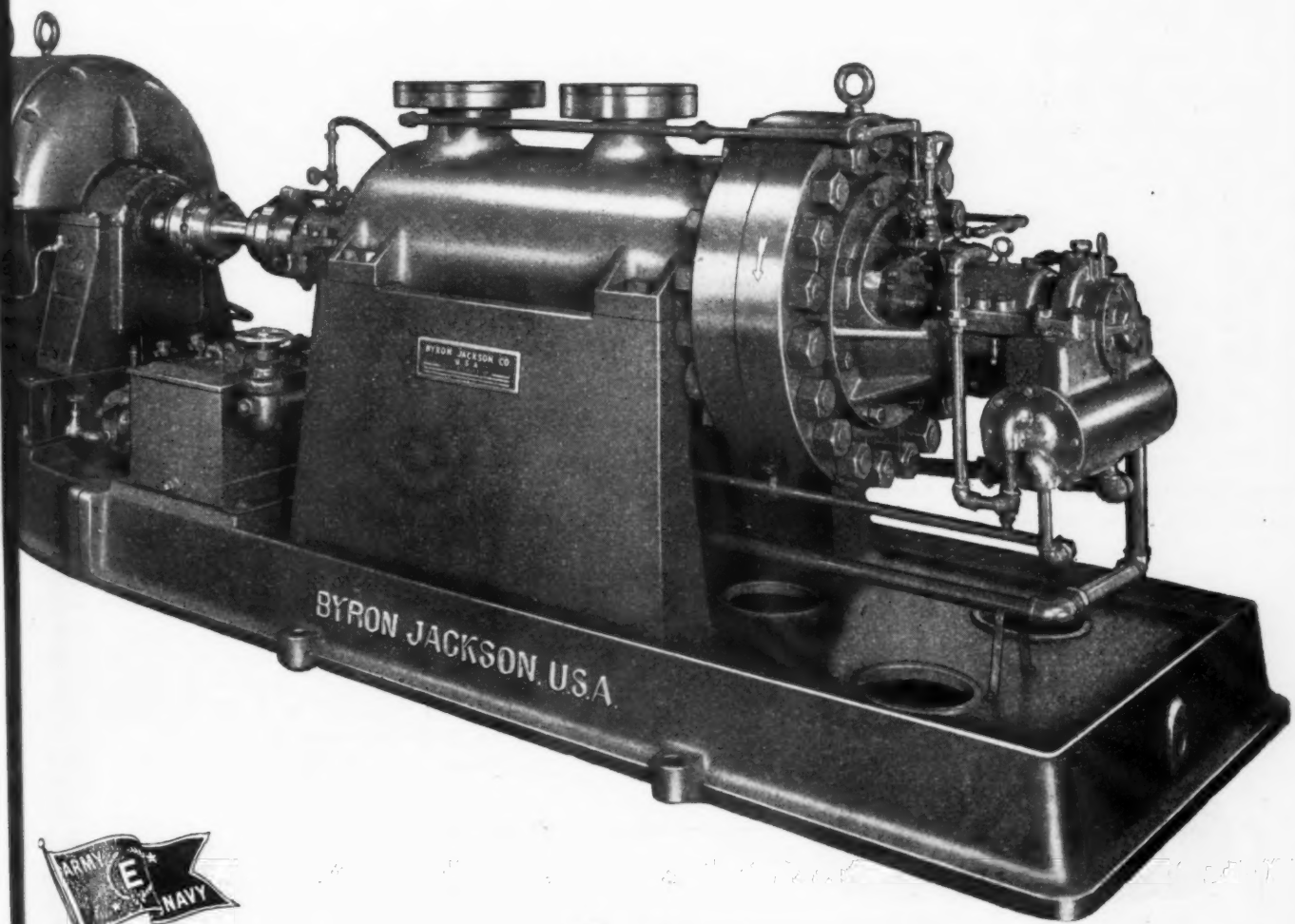
General Elec Co makes these appointments: **R C Hardy,** district mgr, central station div, Cleveland, succeeding the late E F Whitmey. **E A Green** is asst to the mgr, motor div. **Clifford H Beecher** is district auditor, N. Eng. In Pittsfield, **Fred G Stebbins** is sales mgr, capacitor section, and **Edw V Dillon,** asst sales mgr, feeder-voltage regulators, transformer div of central station div. **Mrs Martha Kinzie** has been elected asst secy, radio technical planning board. With **L C F Horle** and **W B Cowlich,** she will process the papers in the board's work, to formulate plans for the technical future of the radio industry and services, including frequency allocation and systems standardization. Planning will be restricted to engrg.

E J Strickland, Los Angeles, has been appointed Pacific Coast editor of POWER. He will also represent three other McGraw-Hill publications—*The American Machinist, Product Engineering* and *Factory*.

Strickland is a graduate of the U.S. Military Academy, West Point, and served a number of years as an officer in the Army. His business experience

includes twelve years of engineering and sales work with the Southern California Gas Co, Los Angeles, and more recently, varied industrial and production-engineering work in the Los Angeles area. His broad, practical experience and wide acquaintance in western power circles will greatly strengthen POWER's representation of the Far West.

BYRON JACKSON Type HDB double case pump for boiler feed and hydraulic press service. Capacities from 150,000 to 1,000,000 pounds per hour, at pressures from 1,000 to 6,600 pounds per square inch,—the highest pressure ever developed by a centrifugal pump.—Detailed Bulletin available.



ARMY E NAVY

Awarded to Los Angeles Plants—1942

Established 1872

BYRON JACKSON CO. - Los Angeles

FACTORIES: Los Angeles & Fresno, Calif., Bethlehem, Pa. • SALES OFFICES: New York, Chicago, San Francisco, Fresno, Salt Lake City, Tulsa, El Paso, Houston

NOW 80 MORE SPECIFIED!

A manufacturer of water filtering systems had need for accurate dependable instruments to measure the flow. After careful consideration they chose

HENSZEY FLOW INDICATORS

Due to the fine performance of these, another order soon followed for 57 more. Now 80 are needed, and the "specs" leave no doubt that Henszey Flow Indicators are desired.

They register the flow from zero to 100% indicating a pulsating flow exactly as it occurs Graduations on the easily read dial are uniformly spaced and give the information direct—without constants. There are only three moving parts—breakdowns due to complicated gears and mechanisms are eliminated. No additional supports are needed—they go right in the line.

If you have a tough flow measuring problem consider Henszey Flow Indicators for the job—now performing in hundreds of manufacturing and processing plants from coast to coast.

Send for Bulletin FI-1.

HENSZEY CO.
Dept. D3
Watertown, Wisconsin

HENSZEY

FLOW INDICATORS

Continuous Blowdown • Distilling Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

Dr Harvey Nathaniel Davis, president, Stevens Institute of Technology and director, Office of Production Research and Development, WPB, has been selected an honorary member of the Institution of Mechanical Engineers in England, the college announced recently.

He is the fourth living American on this distinguished list. The others are Henry Ford, Professor A G Christie, of Johns Hopkins University, and Orville Wright. The late Fred R Low, former editor of POWER, was similarly honored while president of the American Society of Mechanical Engineers.

Dr Davis returned recently from England, where he had been on a government mission for the OPRD and the Combined Production Resources Board of Great Britain, Canada and the United States.

Ammonia Soaks Up Heat

(*Continued from page* 80)

that the room air changes completely once an hour. This represents cooling 2000 cu ft (10x20x10) of air from 90 to 35 F. Weight of saturated air x its specific heat x temperature difference= Btu per hr. Weight of saturated air at 90 F is 0.0709 lb per cu ft. Then: 0.0709 x2000x0.2485 (specific heat) x55=1,938 Btu per hr.

3. *Special loads:* Assume two ¼-hp fan motors operating continuously on the room cooling units, a total of ½ hp. One horsepower equals 2546 Btu, so ½ of 2546 = 1273 Btu (neglecting motor losses).

4. *Product load:* Suppose 500 lb of beef moves in and out of the room every hour, and when put in storage it has a temperature of 90 F. Here again the formula is the same, or, weight x specific heat x temperature difference = Btu per hr. Then: 500x0.74 (specific heat of beef) x55=20,350 Btu per hr. Adding all loads gives the heat that must be removed from this particular cooling space every hour.

1—Insulation loss	3,850 Btu
2—Service load	1,938 Btu
3—Special load	1,273 Btu
4—Product load	20,350 Btu
Total	27,411 Btu

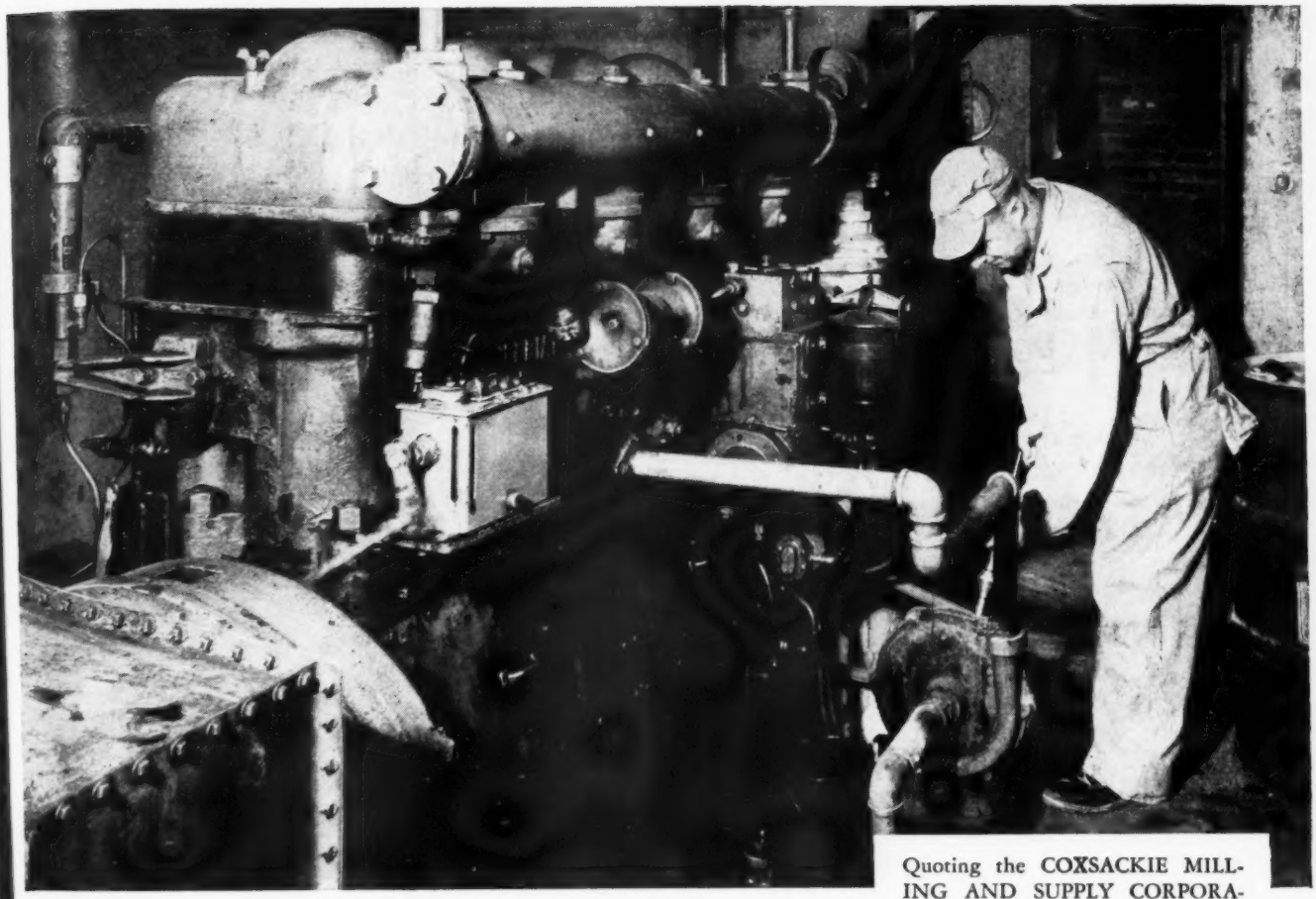
And

$$\frac{27{,}411}{12{,}000} = 2.29 \text{ tons of refrigeration required.}$$

Q 13—Explain the term, one ton of refrigeration.

A—The American Society of Refrig-

Increase power output and cut costs with RING-FREE!



Quoting the COXSACKIE MILLING AND SUPPLY CORPORATION, West Coxsackie, N.Y.: "Two years ago we started using your RING-FREE Motor Oil in our 80 horsepower Diesel that furnishes power, light and heat for our milling operation. We immediately found a reduction of more than ten percent in our oil consumption and a corresponding reduction in the volume of fuel oil needed.

"... we have not had one stuck valve, the rings have remained free and we have a smoother running motor than at any time in eight years ..."

If you recognize engine lubrication as more than a necessary evil... If you fully appreciate the wide range of performance benefits and economies that can be achieved through superior motor oil, then try Macmillan RING-FREE. Keep accurate records and compare. Here's what to expect:

1.—More fuel savings because RING-FREE reduces engine friction *fast,* delivers more power direct to the drive shaft; 2.—A sweeter running engine because RING-FREE lubricates more thoroughly due to fast penetration, high film strength, high heat resistance and long cling; 3.— Longer motor life and lower overhaul bills because RING-FREE reduces wear; 4.— If your engine is carboned-up, a cleaner motor results from RING-FREE because it *removes carbon* while the motor runs.

It will pay you to operate with Macmillan RING-FREE Motor Oil in the crankcases of *all* your motorized equipment — Diesel and gasoline!

MACMILLAN PETROLEUM CORPORATION

50 W. 50th Street, New York 20 • 624 S. Michigan Avenue, Chicago 5 • 530 W. 6th Street, Los Angeles 14

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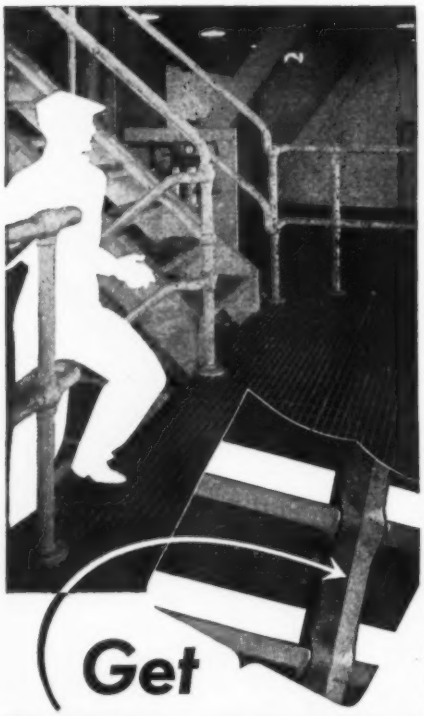
MACMILLAN RING-FREE MOTOR OIL

REDUCES WEAR BY REDUCING FRICTION



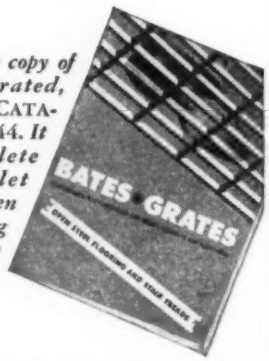
Get

BATES-GRATES

FOR YOUR OPEN STEEL FLOORING AND YOUR FLOORS, TOO, WILL BE CLEANER AND SAFER

See that scraper tread—and the crisp lines of the Hex cross bar? *That* gives a safer and cleaner tread and at the bottom of those cross bars you find clean, well-shaped fillets made by the metal displaced in the Bates patented process—no metal is lost. The weld is cleaner and stronger. The *floor* is cleaner and stronger. Yet, open steel flooring made under Bates patents costs no more.

Write for copy of well-illustrated, 8½" x 11" CATALOG NO. 43-44. It gives complete data on fillet welded Open Steel Flooring and Stair Treads.



WALTER BATES COMPANY, INC.
JOLIET • ILLINOIS
OPEN STEEL FLOORING • STAIR TREADS

erating Engineers defines the standard commercial ton of refrigeration as the transfer of 200 Btu per minute, or 12,000 Btu per hour. It is the basis of all refrigeration calculations, whether for cold storage, air conditioning, ice making or ice-cream manufacture. When a person says he has a 70-ton ice plant—that is something else. He means that he can make 70 tons of ice in 24 hours, and the rated refrigerating tonnage of his plant, as defined above, might be 150.

Q 14—What is a reasonable temperature difference between the outgoing cooling water and outgoing liquid ammonia from a condenser?

A—This depends upon condenser efficiency, its condition, and the quantity of water put through it. Here are the actual operating conditions in a typical plant:

Ammonia suction pressure, 38 psi gage. Ammonia discharge (condensing) pressure, 138 psi gage. Condenser-water temperature 48 F, water from condenser 59 F, and ammonia leaving condenser 55 F.

Theoretically, ammonia leaving a counterflow condenser should have almost the same temperature as that of the entering water. Fig. 5 illustrates the action in a shell-and-tube unit under these conditions.

Q 15—Draw a diagram and explain the pressure-enthalpy refrigeration cycle for ammonia.

A—*Enthalpy* is the modern word for what was originally called *heat*—such as heat of the liquid or of the vapor. U. S. Bureau of Standards tables have not been brought up to date in this respect.

Starting with the liquid in receiver *C*, Fig. 6X, ammonia expands at the expansion valve with a large drop in pressure and small increase in volume, as indicated by line *a-b* in diagram Y. Next, it starts to boil in the cooling coil, changing from liquid to gas with a small drop in pressure and large increase in volume, such as line *b-c*. This is where it does the work of cooling.

Then the vapor reaches the compressor where its volume is reduced and pressure increased, line *c-d*. This is where work is done on the ammonia. From the compressor, cycle is completed in the condenser, where the gas changes to a liquid again, with, of course, a decrease in volume, line *d-a*. Theoretical temperatures and pressures given on the schematic layout indicate different phases of the cycle in a typical plant. In actual practice these values vary somewhat.

BRICKSEAL

An Easy Way to Conserve Refractories

1—*Paint or spray brickwork with BRICKSEAL.*

2—*Light fire. Boiler is ready for instant use.*

Heat of fire-box vitrifies Brickseal permanently into all refractory pores, cracks and joints, forming a highly-glazed, monolithic coating, impervious to slagging, clinkering, corrosive gases, flame abrasion and air infiltration.

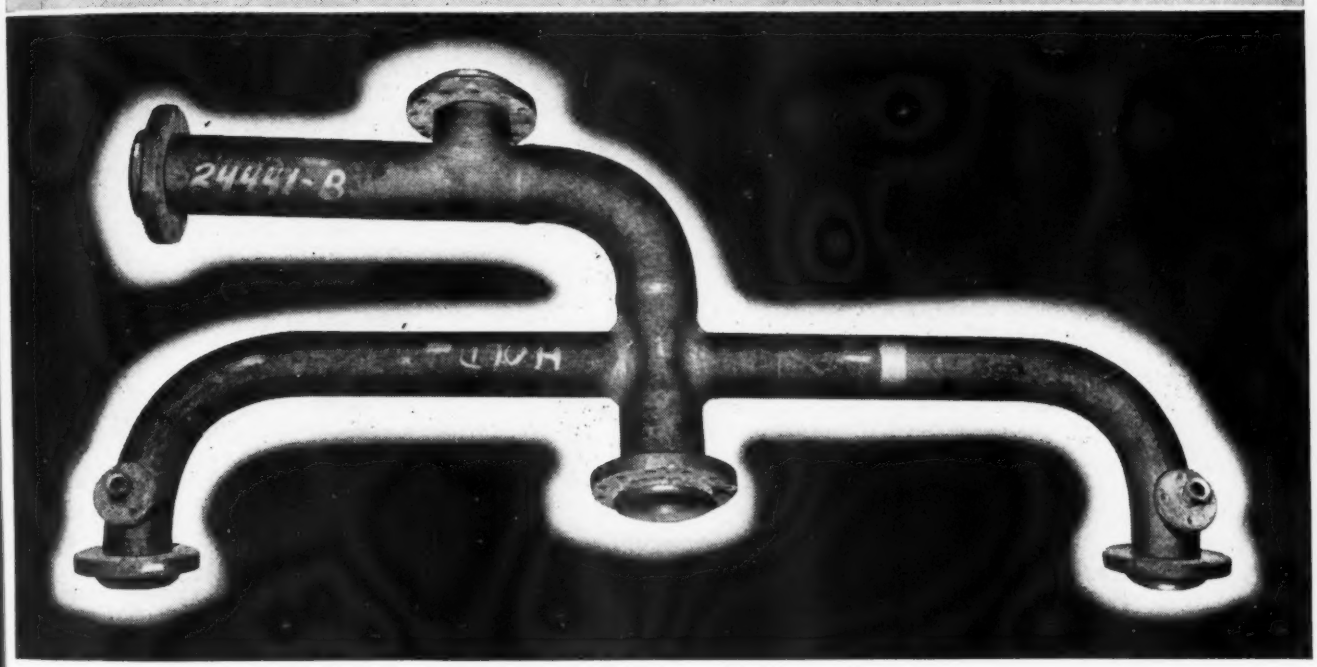
Brickseal will not crack or peel off due to sudden temperature changes, because it remains semi-plastic until the furnace cools. Brickseal prolongs the life of new or old refractories for a fraction of the cost of relining.

Write for Brickseal sample or representative, today.

BRICKSEAL
REFRACTORY CO.
1029 CLINTON ST., HOBOKEN, N. J.

23 PIPING SPECIALISTS

REQUIRED TO PRE-FABRICATE THIS SUBASSEMBLY



This piece of pre-fabricated piping doesn't look too difficult (and it isn't as piping jobs go) yet 23 specialists from engineering to testing contributed their knowledge and skill to it.

If it were made in the field, most of these specialists would have to be there . . . (not an easy matter in these days of skilled labor and transportation shortages) or a large part of the work would have to be done by men not too well trained for it. Further, they would not have the advantage of shop equipment which supplements the skill of the piping specialists employed by a qualified pipe fabricator.

Pre-Fabricated Piping is delivered to you in a series of subassemblies, each made to fit exactly into the total plan. Each is shop tested, accurately aligned, heat treated and stress relieved when necessary, thoroughly cleaned and inspected. Erection in the field is then a simple, rapid and economical operation.

PRE-FABRICATED PIPING IS BETTER PIPING

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

PFI THE PIPE FABRICATION INSTITUTE

1108 CLARK BUILDING • PITTSBURGH, PA.

KEWANEE SCOTTIE JR BOILER

• High Pressure steam with this low cost boiler designed for economical operation. Compact, yet easily accessible.

For 6" scale with pipe diameter markings, write, Dept. 99-K3

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS
Division of AMERICAN Radiator and "Standard" Sanitary Corporation

EXTRA VISIBILITY?

Get it from Pyrex brand Broad Red Line Gauge Glasses

When you want extra visibility, call for PYREX brand Broad Red Line Gauge Glasses. You don't have to guess where the water line is, because it stands out vividly. You can't miss it, even from a distance.

Illuminated from the rear, the transparent Broad Red Line is greatly magnified by the water column. There's no doubt and no eye strain with PYREX Broad Red Line Gauge Glasses.

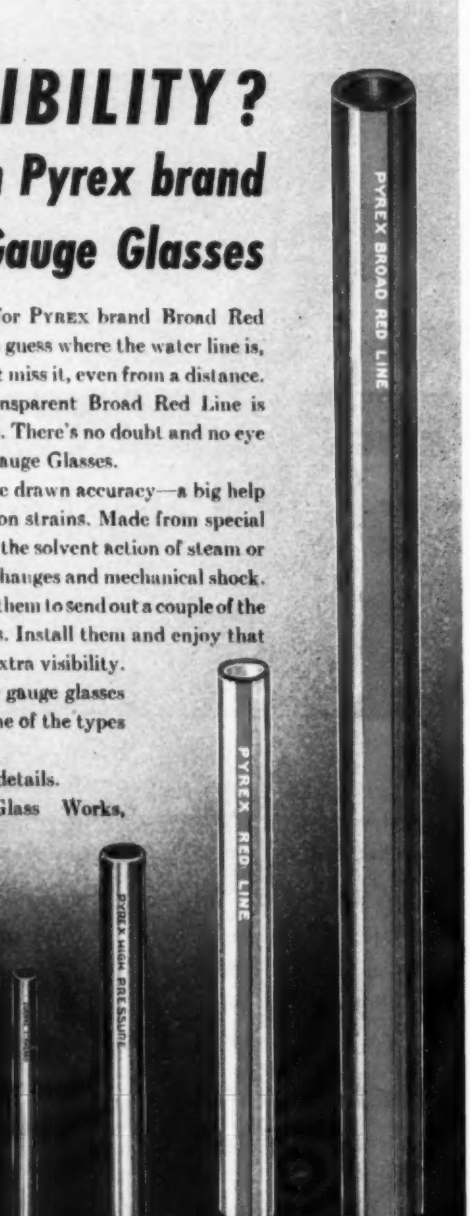
These glasses are made with machine drawn accuracy—a big help in preventing breakage from installation strains. Made from special borosilicate glass, they are resistant to the solvent action of steam or hot water and to sudden temperature changes and mechanical shock.

Call your Mill Supply House and tell them to send out a couple of the PYREX Broad Red Line Gauge Glasses. Install them and enjoy that feeling of security which results from extra visibility.

Whatever particular condition your gauge glasses must meet, you'll find the answer in one of the types in the CORNING and PYREX Line.

Write for Bulletin 817. It gives full details.

Industrial Division, Corning Glass Works, Corning, N. Y.



PYREX brand High Pressure—resistant to thermal and mechanical shock and attack of steam and hot water. Machine drawn accuracy.

PYREX brand Red Line—Same but with added visibility afforded by enameled red line.

PYREX brand Broad Red Line—Same but with fused-in broad red line for extra visibility.

CORNING Standard—For moderate pressures. Long-lasting. Machine drawn accuracy.

"Pyrex" and "Corning" are registered trade-marks and indicate manufacture by Corning Glass Works.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses BRAND

Gas Compressor Stations

(*Continued from page* 92)

by suction pressure, discharge pressure or quantity of gas compressed. Quantity of gas compressed can also be varied automatically by changing compressor speed up to a certain point and by clearance pockets from there until compressor output is zero. In installations handling a wide range of suction and discharge pressures, controlling compressor torque eliminates danger of overloading the unit when pressure conditions exist that might damage working parts. This is done by unloading the compressor cylinder when it operates in an unfavorable range.

Compressor-Station Buildings: Higher engine speeds reduce size of building necessary to house main units. For example, a main-line station consisting of six 1000-hp V-type engines shows a floor-space requirement of 0.7563 sq ft per hp, and a volume requirement of 12.634 cu ft per hp. This allows 10 ft between end engines and wall and 5-ft alleyway around all units. The same horsepower in slow-speed engines would require 1.737 sq ft per hp and 24.313 cu ft per hp. The higher-speed engines would also save 90 cu yd of foundation concrete, about 36%.

A standard main-line-station building generally consists of a steel framework resting on a solid concrete basement wall carried up to main floor level. Basement floor rarely sets more than four ft below grade line, which allows compressor piping to come out of the station above grade. Outside headers rest on concrete supports, with valves in plain sight of operators. Catwalks to each valve provide convenience and safety.

A solid brick wall rises from floor to window-sill level and corrugated transite forms the rest of the walls and roof. Steel-sash ventilating windows should be as airtight as possible. Although considered a needless expense by some operators, an overhead crane reduces maintenance cost; capacity should exceed two tons.

An exhaust-gas furnace or boiler, supplemented by a gas- or oil-fired boiler for emergencies, usually handles heating. In the Dust Bowl regions, supplying stations with water-washed air reduces maintenance costs. Another innovation involves placing motor-driven water pumps in a doghouse at the cooling tower and controlling them from the switchboard. This decreases length of water lines and building space needed.

Grinding mills used to reduce ore to appropriate size for treatment

NICKEL AIDS THE MINING INDUSTRY

to KEEP 'EM PRODUCING!

Weapons for war get their start underground.

And it's modern mining machinery that speeds 'em on their first step to Berlin and Tokio.

Through research and development work in the pre-war years, manufacturers have pioneered many innovations that make today's mining equipment amazingly efficient.

And in this war emergency, the industry is making the most of that equipment... working it harder, longer, often beyond rated capacity ... spurred on by the limitless demands of war.

One reason the equipment holds up so well ... thanks to the foresight of design engineers... is that many of the critical parts are made of Nickel alloyed materials.

Nickel goes a long way to make those parts longer-lasting and more dependable ... tougher, stronger, more resistant to corrosion.

Hence, the use of Nickel is now so widespread that Nickel Alloys fortify nearly all kinds of mining and milling equipment parts ... from drill bits and crusher frames to skips and cages, from ball mill liners to mine car axles.

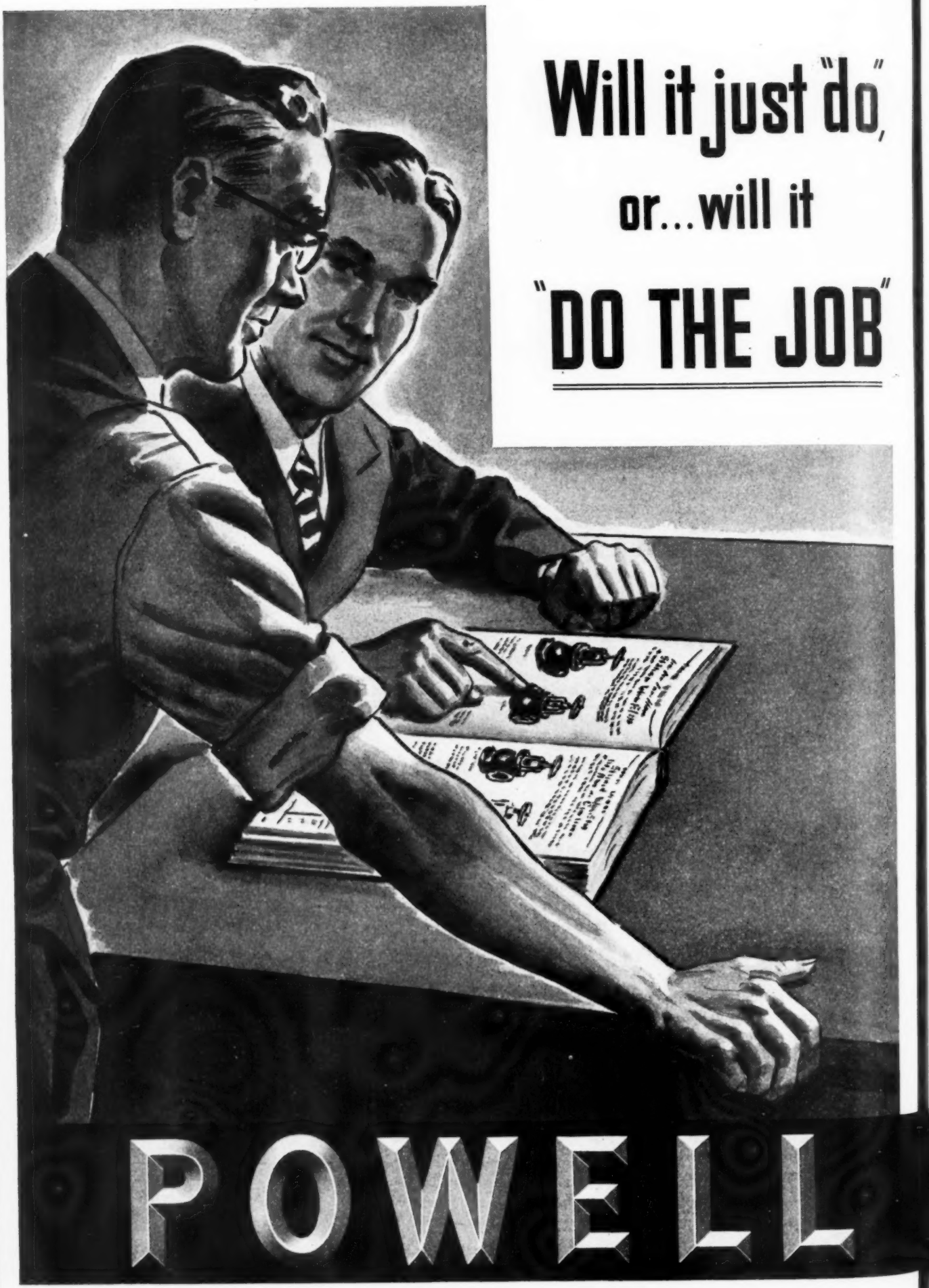
Throughout the years of research and planning behind this progress, it was our privilege to cooperate with the engineers who desired help in the selection, fabrication, and heat treatment of alloys. Whatever *your* industry may be ... if you'd like to have such assistance ... counsel and printed data are available on request.

New Catalog Index

New Catalog C makes it easy for you to get Nickel literature. It gives you capsule synopses of booklets and bulletins on a wide variety of subjects — from industrial applications to metallurgical data and working instructions. Why not send for your copy of Catalog C today?

★ *Nickel* ★

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall St., New York 5, N. Y.*


Will it just "do,"
or...will it
"DO THE JOB"
POWELL

"There is a valve that will "*do*"—or "there *is* a POWELL Valve that will *do the job*"—what a difference in meaning.

But as long as you have POWELL Engineering at your service, you'll never have to make a valve "do"—because POWELL not only has a complete line of standard valves as listed in our general catalog but—POWELL Engineering is ready at all times to offer *specialized* service.

Shown here are three of POWELL'S complete line of Steel Valves. These are especially suitable for controlling *steam* or *boiler feed* lines. POWELL Steel Valves are also available in both plain carbon molybdenum steel and highly alloyed steels for *special boiler feed* service.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

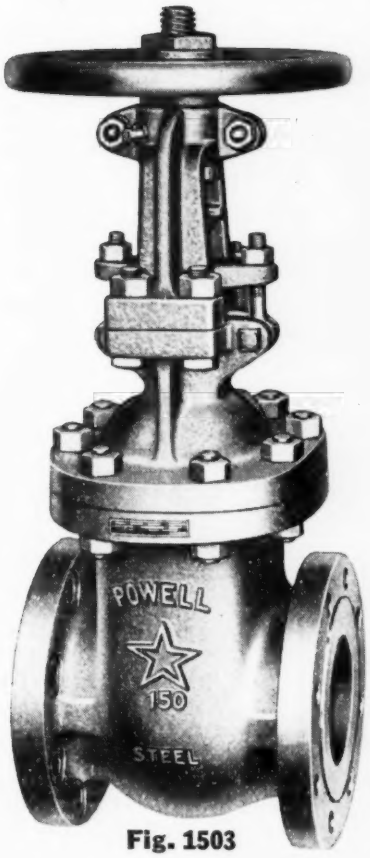


Fig. 1503

Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Sizes 1" to 24", inclusive.

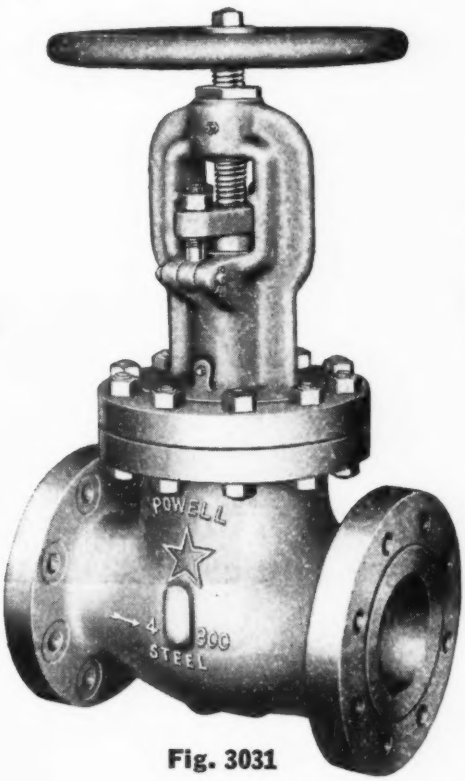


Fig. 3031

Fig. 3031—Class 300-pound Cast Steel Globe Valve, with flanged ends, outside screw rising stem, bolted flanged yoke. Sizes, 1" to 10", inclusive.

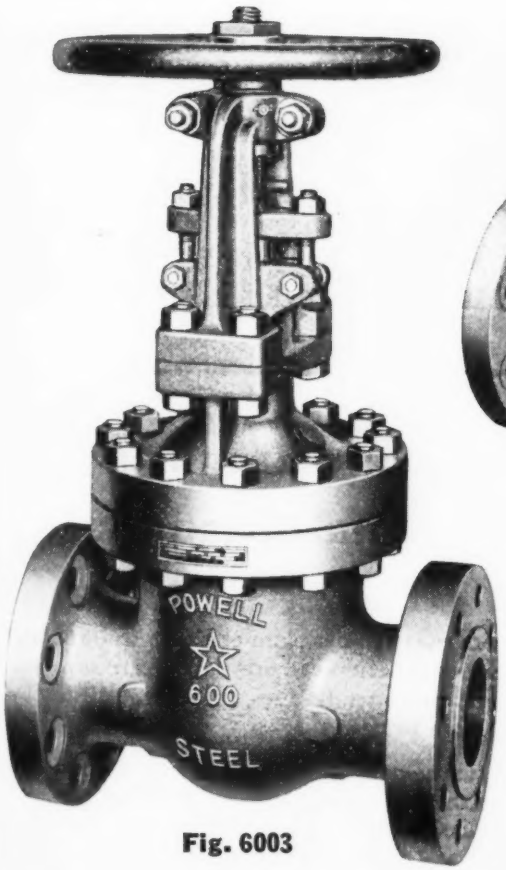


Fig. 6003

Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Sizes, 1" to 24", inclusive.

VALVES

Stopping boiler troubles before they become critical. Hall Laboratories' careful, periodic analysis of boiler water from your plant, coupled with simplified control analyses by the plant personnel, uncovers boiler troubles before they become serious, permits preventive treatment which keeps plants in continuous operation.

Straight from the shoulder facts

· · · ON SCIENTIFIC BOILER WATER CONDITIONING

PROBABLY every power plant engineer who reads this not only believes in preventive care as protection against boiler failures, but to the best of his knowledge practices it.

There can be only one reason, therefore, for the endless recurrence of problems arising from scale, corrosion, carryover and embrittlement. The measures he can and does take don't go far enough. The science of boiler water conditioning and the

HALL SYSTEM

Latest X-ray Equipment shows up constituents in complex boiler deposits which may be missed by other forms of analysis. This is an extra assurance you have that Hall Treatment will be correct.

Hall Service in a Nutshell

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. **Minimizes boiler outages caused by water.**
2. **Helps maintain highest efficiency.**
3. **Establishes non-embrittling water.**
4. **Minimizes carryover.**
5. **Prevents corrosion in boilers and associated equipment.**
6. **Prevents deposition in water lines and cooling systems.**

For controlling silica scale and corrosion in high-pressure boilers

The new Hall P-T-X System, based on a potassium equilibrium instead of sodium, is showing remarkable results in eliminating troubles in high-pressure boilers which had previously defied solution.

remedying of trouble-making conditions call for the specialized supervision of the experienced physical chemist. Few engineers have either the preparation or time to meet this additional requirement.

That explains why even the most modernly equipped and competently staffed power plants rely on the cooperative assistance of Hall Laboratories.

Hall preventive care is an original and exclusively Hall development, the product of twenty years' experience in keeping the nation's boilers on the line. It cannot be duplicated because no other service in the world can offer its scientific background, substitute for its Hall-trained field personnel, or even approach its many contributions to industrial water treatment.

And, now to this record has been added a new accomplishment—the Hall P-T-X System—which provides the *first* actual solution for many problems originating in the steam-water interfaces of the boiler system, particularly metal corrosion and siliceous scales.

Why not let us explain more fully how Hall service in preventive care will enable you to share in this knowledge and experience?

HALL LABORATORIES, INC., Hagan Building, Pittsburgh 30, Pa.

Subsidiary of Hagan Corporation

of Boiler Water Conditioning

HAGAN
HALL
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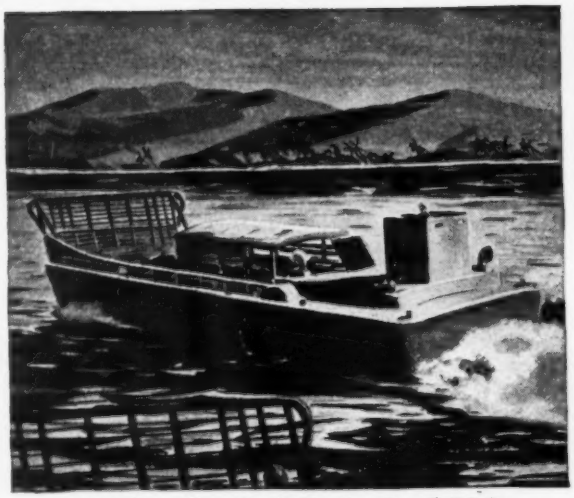
CALGON

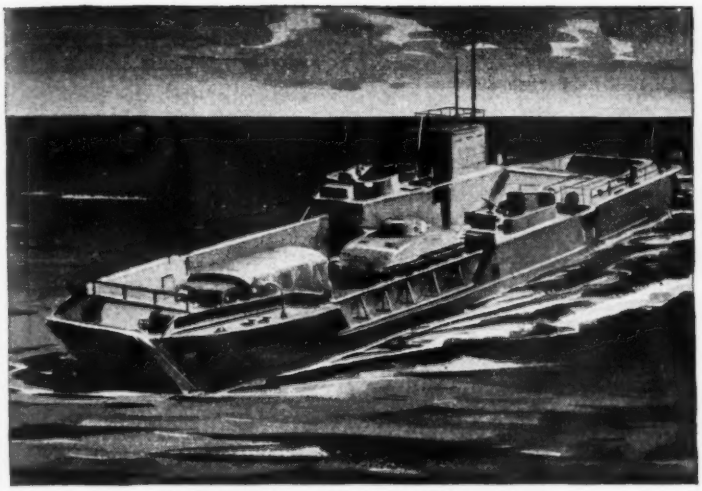


LCM (Landing Craft Mechanized) 50 ft.

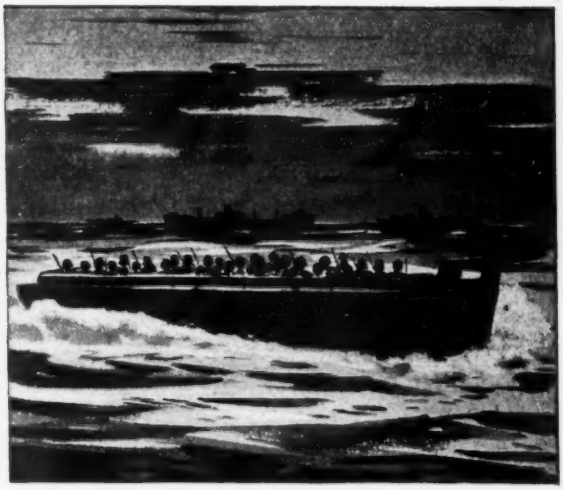
LCI (Landing Craft Infantry) 157 ft.

LST (Landing Ship Tanks) 328 ft.

KEEP AMERICA STRONG
BUY MORE WAR BONDS



LCT (Landing Craft Tanks) 105 ft.



LCV(P) (Landing Craft Vehicle Personnel) 36 ft.

AMERICA'S FIGHTERS MOVE IN _WITH GM DIESELS

IN the face of enemy fire these remarkable invasion boats nose in on enemy shores and pour out America's tough fighters and fighting equipment.

They move on split-second orders—must get in and out again by themselves—on the dot, come hell or high water.

It's the kind of service that calls for utmost reliability and quick response.

In these capable craft—from the 36-foot LCV(P) to the big 328-foot LST—you find the engines America and our Allies know so well, General Motors Diesels.

To these engines are assigned the jobs that call for the greatest dependability the engine world knows.

GM
GENERAL MOTORS
DIESEL POWER

ENGINES . . . *15 to 250 H.P.* . . **DETROIT DIESEL ENGINE DIVISION,** *Detroit, Mich.*
Engines of this series power the LCI and all the smaller landing craft

LOCOMOTIVES . . . . . **ELECTRO-MOTIVE DIVISION,** *La Grange, Ill.*
Engines from this Division propel the giant LST vessels

ENGINES . . *150 to 2000 H.P.* . . **CLEVELAND DIESEL ENGINE DIVISION,** *Cleveland, Ohio*
More than 40 types of Navy vessels are powered by engines of this Division

SIMPLICITY OF DESIGN MEANS EASIER MAINTENANCE.

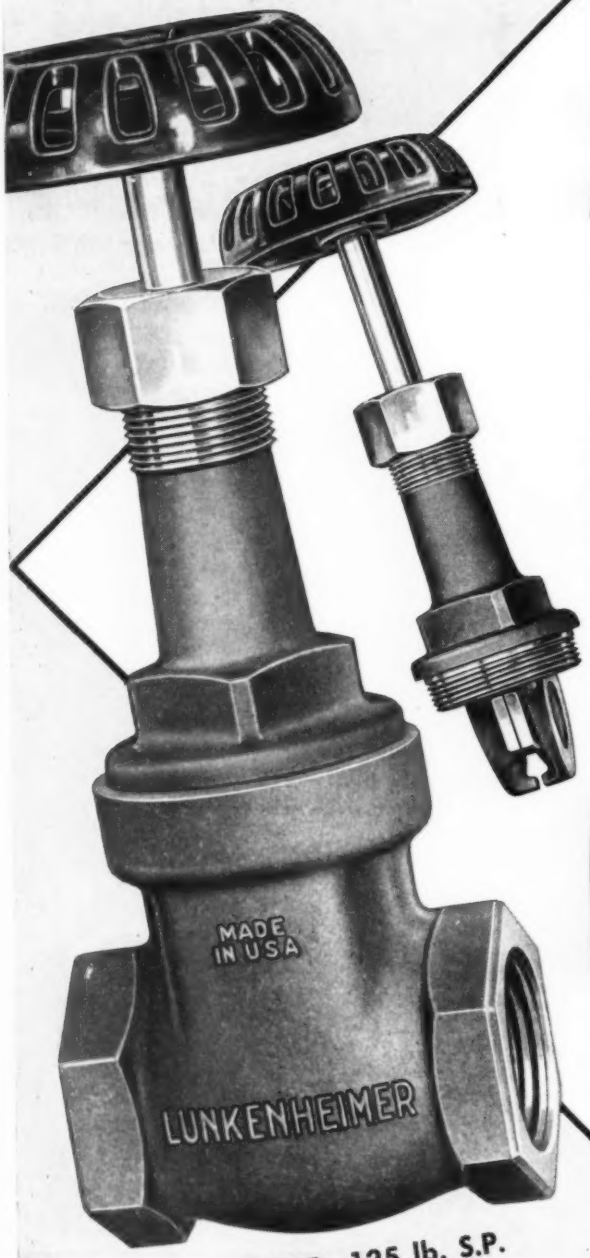


Fig. 2125—125 lb. S.P.
Bronze Double Disc Gate
Rising Stem

It fits perfectly...

One body takes either the rising stem or non-rising stem trim assembly. A timely feature when it's necessary to convert from one type to the other. Simply loosen the trim assembly and lift out. The body remains in the line.

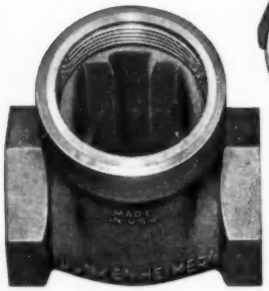


Fig. 2129—125 lb. S.P.
Bronze Wedge Disc Gate
Non-Rising Stem

LUNKENHEIM

GOOD VALVE CARE is just good business

NOW, especially, when the demand for valves is taxing deliveries, it is imperative that you make your present valves last longer and serve better.

It's a challenge to every maintenance man to keep an eagle eye on the valves he now has in service... to see that they are checked and serviced regularly and thus forestall, as far as possible, the need for replacements.

Lunkenheimer Valves are easy to keep in good condition. Simplicity of design, with a minimum of working parts, makes them readily accessible for inspection and maintenance follow-up.

Let your Lunkenheimer distributor help you with your maintenance, repair and operating problems. His facilities and experience are at your call.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

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NEW YORK 13 CHICAGO 6
BOSTON 10 PHILADELPHIA 7

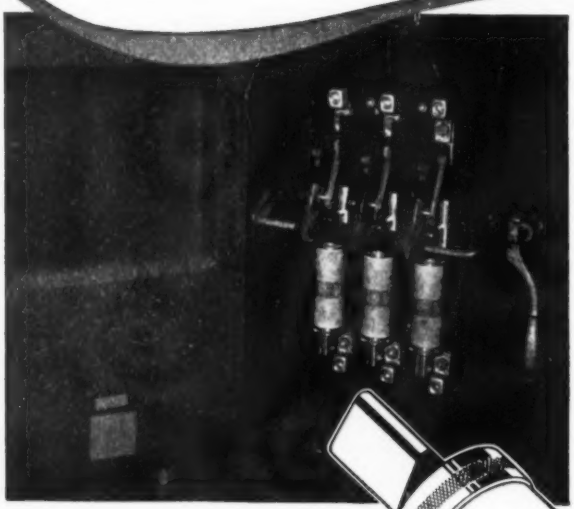
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

ER VALVES...

No. 11012-53-42

"To Prevent Needless Welder Shutdowns at Globe Shipbuilding Company We Installed BUSS Fuses,"

Says CONTRACTOR, MR. FRANK MAHAN OF BENSON ELECTRIC COMPANY, SUPERIOR, WISCONSIN



"At the Benson Electric Company," adds Mr. Mahan, who is manager and chief electrical engineer, "we have standardized on BUSS Super-Lag fuses for the past 7½ years, using them exclusively on all wiring and motor installation jobs.

"We have found that BUSS Super-Lag links and the design of BUSS fuse cases can be depended upon to prevent needless shutdowns of heavy starting equipment such as welders and motors. It is doubly important in shipyards like the Globe Shipbuilding Company, that are rushing material for war, that outages be held to an absolute minimum.

"This installation includes 10—400 ampere feeder circuit switches. Off each is run 24—60 ampere circuit switches serving electric welders.

"From our past experience we are sure that the installing of BUSS Super-Lag fuses at Globe Shipbuilding Company will eliminate many needless production losses."

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES in the design of the FUSE-CASE help make it possible...

plus

The SUPER-LAG development in the FUSE-LINK completes the job.

BUSS Super-Lag

You, too, can profit by standardizing on BUSS fuses

Mr. Mahan's experience that led him to specify BUSS fuses at Globe Shipbuilding Company is a typical reaction of men who have tried these fuses. It is proof that shutdowns caused by needless blows can be prevented—and adequate protection can be provided in the same protective device.

As for BUSS Super-Lag fuses—the experience of thousands of plants throughout all industry has proven time and again that by using them you can obtain trouble-free protection at a lower overall cost than with any other renewable fuse.

They require no maintenance or periodic inspection. They don't open needlessly. If one opens, you know there is some fault that needs correction.

Here is Why BUSS Super-Lag Fuses Greatly Reduce or Entirely Prevent Needless Blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus, excessive heat which causes fuses to blow when they should not is prevented.

The fuse link used is the famous "BUSS SUPER-LAG." It has lag-plates attached which give it a long time-lag so that unusually heavy starting currents or other harmless overloads will not cause the fuse to blow.

And Here is How to Solve the "Shutdown Problem" in Your Own Plant

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses give.

BUSSMANN MFG. CO., University at Jefferson, St. Louis, Missouri, *Division McGraw Electric Company.*

FUSES Sold Through Wholesalers

LOOK to CLARAGE

FOR WAR AND POST-WAR AIR HANDLING AND AIR CONDITIONING NEED

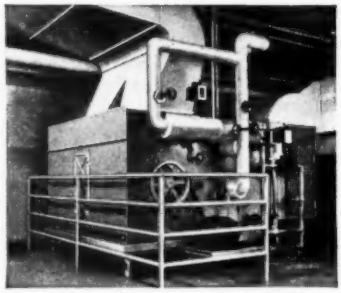
Today, as since Pearl Harbor, Clarage is playing an important part in meeting the enormous demands of industry, shipbuilding and government for air handling and conditioning units.

★ Tomorrow, after Victory, our long pre-war experience, plus notable research advancements born of war, will prove *exceedingly profitable* to those with peace-time requirements.

★ If you have an immediate and war-essential problem, look to Clarage NOW for units expertly designed and specifically built to your particular job — *and for prompt deliveries.*

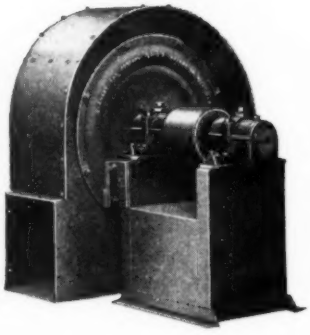
★ Or, if you are thinking in terms of post-war service, look to Clarage NOW for any desired planning and cost-determining assistance.

★ Thus, when the time comes for action, your installation may be completed without delay and may incorporate the latest improvements in air handling or conditioning technique and equipment.



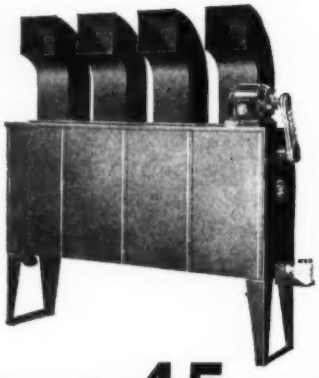
AIR CONDITIONING

Clarage builds both central station and unit air conditioners — suitable for complete conditioning, heating or cooling, humidifying or dehumidifying. The unit conditioners (floor and suspended types) can be easily installed without costly building alterations; used with or without duct work.



EXHAUST FANS

Clarage Exhaust Fans are made to cover all kinds of exhaust and blow pipe and pneumatic conveying requirements; used for dust collecting, removing fumes, and for conveying through pipes such materials as shavings, grains, etc. Fan Wheels statically and dynamically balanced. Famous Clarage dust-proof, oil-tight bearings standard equipment.



LARGE AREA HEATERS

Clarage Unitherm Unit Heaters are designed for service in factories, mills, etc. Equipped with centrifugal fans, they deliver heat at high velocity spreading it over wide areas. Both floor and suspended types available. Also Clarco (propeller fan) unit heaters for small factory areas, offices, stores—easily installed along walls or at ceiling.

IMMEDIATE HELP IN 45 CITIES

Each Clarage branch office is manned by experts — by Clarage engineers long experienced in satisfactorily meeting air handling and air conditioning requirements of every conceivable kind.

★ *Whether you have a war-time or post-war problem, you will find these application engineers eager to cooperate. You will like the intelligent way in which your inquiry is handled.*

★ Illustrated above are only a few of the units and systems built by Clarage. Write for catalog showing our complete line.

COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

Clarage Fan Company Kalamazoo, Mich.

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

GET THIS
BETTER VALVE SERVICE

FASTER OPERATION
Quick-acting threads open and close faster . . . won't stick or freeze.
FULL PRESSURE REPACKING
Because pressure is not transmitted to stem.
TOUGHER SEATS & PLUGS
These can be even super-hardened for extra severe service.
CHAPMAN

GET CHAPMAN LIST 960

Available in sizes from ¼" to 2" . . . for all pressures up to 800 lb. at 750° F., or 1500 lb. cold working pressure.

THE FORGED STEEL GATE VALVE WITH THE L-O-N-G-E-R LIFE!

THE CHAPMAN VALVE MFG. COMPANY

INDIAN ORCHARD, MASSACHUSETTS

GLOBE STEEL TUBES · · Basic Material in the Construction of All Types of Military Equipment

Airplanes, ships, tanks, trucks, jeeps, water stills, bail-out oxygen bottles for aviators, torpedoes, bombs and other types of ammunition, rolling kitchens — nearly every kind of front line and back-of-the-lines equipment requires steel tubing as an essential component.

The physical "specs" for these tubes vary all the way from high strength for support and pressure applications to high resistance to corrosion from food acids or exhaust gases.

Globe Seamless Pressure and Mechanical Tubing, Globe Stainless Steel Tubing (Seamless and Gloweld) and Globeiron Seamless Tubing have helped solve most problems in steel tubing encountered by the builders of equipment for our armed forces.

Globe engineers and Globe production facilities have rendered service to many manufacturers in carrying on wartime activities. Globe's completely equipped chemical and physical laboratory is constantly available for any tests desired by users of steel tubes.

GLOBE STEEL TUBES CO., *Milwaukee 4, Wisconsin*

★ STAINLESS TUBES
★ BOILER TUBES
★ GLOBEIRON TUBING
★ GLOWELD TUBES

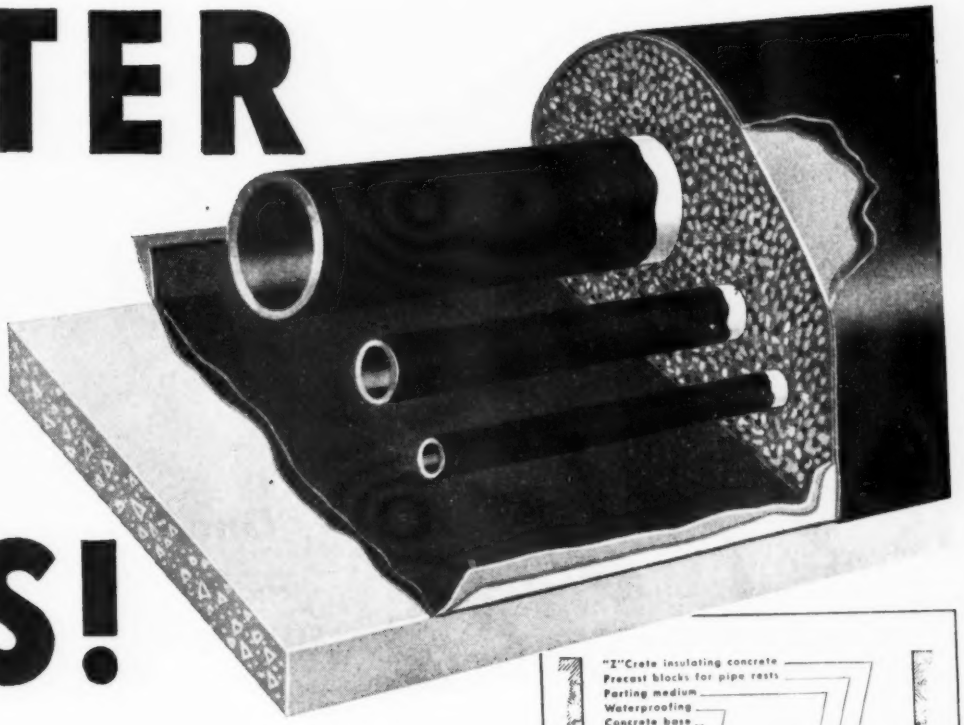
GLOBE TUBES

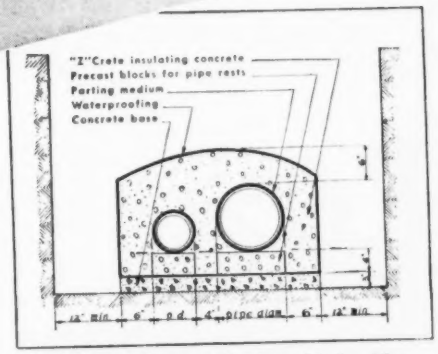
★ CONDENSER AND HEAT EXCHANGER TUBES
★ MECHANICAL TUBING

"Z"crete

UNDERGROUND STEAM LINE INSULATION

BETTER 6 WAYS!





Typical straight run with pipes side by side

The truly amazing "Z"crete system is the modern, superior method of insulating underground steam or other types of piping. It is a *new, fast, practical* way of installing insulation and offers many advantages.

1 It creates a continuous, unbroken covering of insulation around the pipes which affords greater operating efficiency and greatly simplifies waterproofing.

2 It forms a solid covering of permanent water-repellent insulation around the pipes which eliminates joints, hollow spaces or conduits which can fill with water should the waterproofing leak.

3 It makes an embedment of insulation in which the pipes are buried that can be very simply and efficiently waterproofed on all sides at time of installation.

4 It provides a highly efficient insulating material of a permanent nature composed of "Z"crete aggregate, Portland cement and a special integral waterproofing.

These materials combine to form an insulating concrete which is not subject to disintegration upon wetting, is fireproof, chemically inert, rotproof and integrally water-repellent.

5 It minimizes the danger of damage to the insulation or waterproofing due to shipping or handling because both are installed after the pipe is laid.

6 In short, it greatly simplifies the whole problem of installing and insulating underground pipe lines.

Completed "Z"crete System before backfilling

For information and engineering data, write to

UNIVERSAL ZONOLITE INSULATION CO.
DEPT. P1, 135 S. LA SALLE ST., CHICAGO 3, ILL.

MAIL COUPON

Universal Zonolite Insulation Co.
Dept. P1, 135 S. La Salle Street
Chicago 3, Ill.
Please send me full information about the "Z"crete systems for underground pipe insulation.

Name.....

Address.....

City.....*State*.....

Increase Your Manpower with ROTO TUBE CLEANERS

One-man operation saves labor and time

Roto Tube Cleaners, equipped for one-man operation, are relieving the acute shortage of help in hundreds of plants throughout the country. An air valve on the motor permits the operator himself to control the air, eliminating the need for a helper, and saving time-loss due to signalling. Roto offers you the kind of tube cleaning performance that you need to meet today's critical requirements.

The ROTO Company
145 Sussex Ave., Newark 1, N. J.

Write for Working Sample
Send for 36 page catalog.

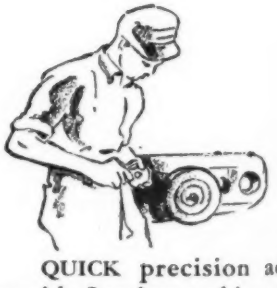
Put "AMBEST" to a long life test on any tough job

EUREKA

This UNIVERSAL packing — of long, pliable, anti-friction metallic alloy strands—assures low cost, long life packing protection and easy application on any rod in good condition. "AMBEST"—available for all pressures and temperatures up to 550° F. — is recommended for pumps, compressors, engines, throttles and valve stems. All needs are supplied by one packing when you use "AMBEST."

EUREKA PACKING CO., 294-296 46th St., BROOKLYN 20, N. Y.

keep step with modern precision methods



QUICK precision adjustment with Laminum shims helps modern machine design, construction and operation . . . sets a new pace in production efficiency.

Shims cut to your specifications. Stock shims of materials obtainable from your dealer. Write us for further information and shim application chart.

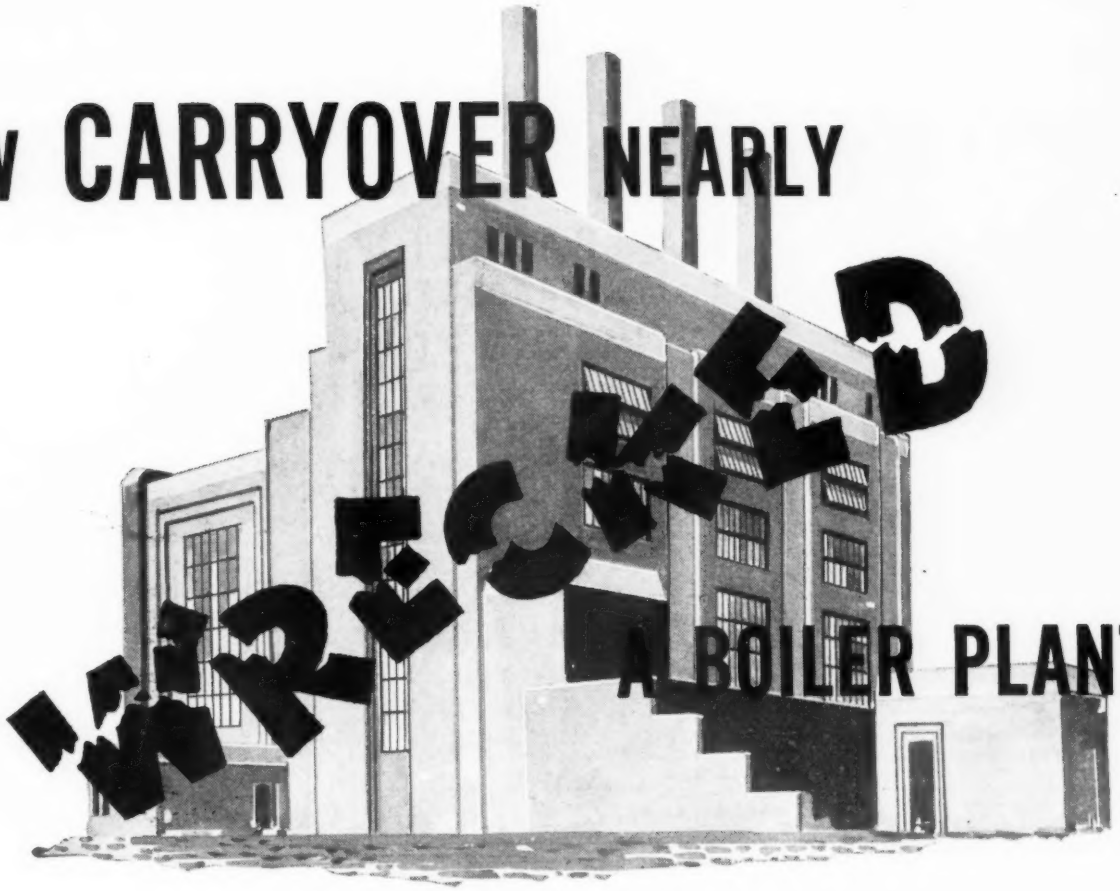
Laminated Shim Company
Incorporated
61 Union Street • Glenbrook, Conn.

LAMINUM

THE SOLID SHIM THAT peels FOR ADJUSTMENT

2041

HOW CARRYOVER NEARLY WRECKED A BOILER PLANT!



A large mid-western oil refinery, generating 2,000,000 lbs. of steam per day, was plagued with a serious carryover condition which was working havoc on superheater tubes, turbine blades, steam lines, valves and traps. An attempt to minimize carryover by maintaining the almost unbelievable blowdown rate of 25% failed to correct the condition; superheater tubes continued to burn out so rapidly that the superheaters were removed in a final effort to keep boilers on the line... but to no avail.

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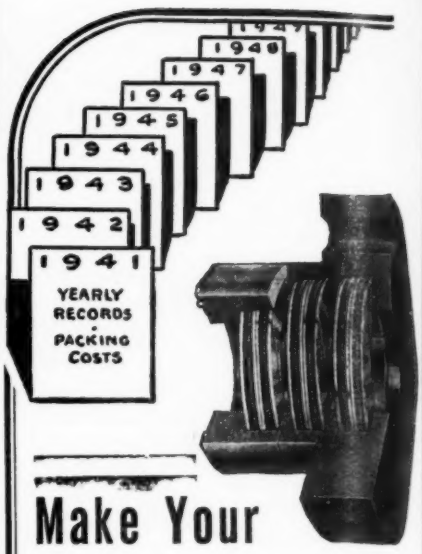

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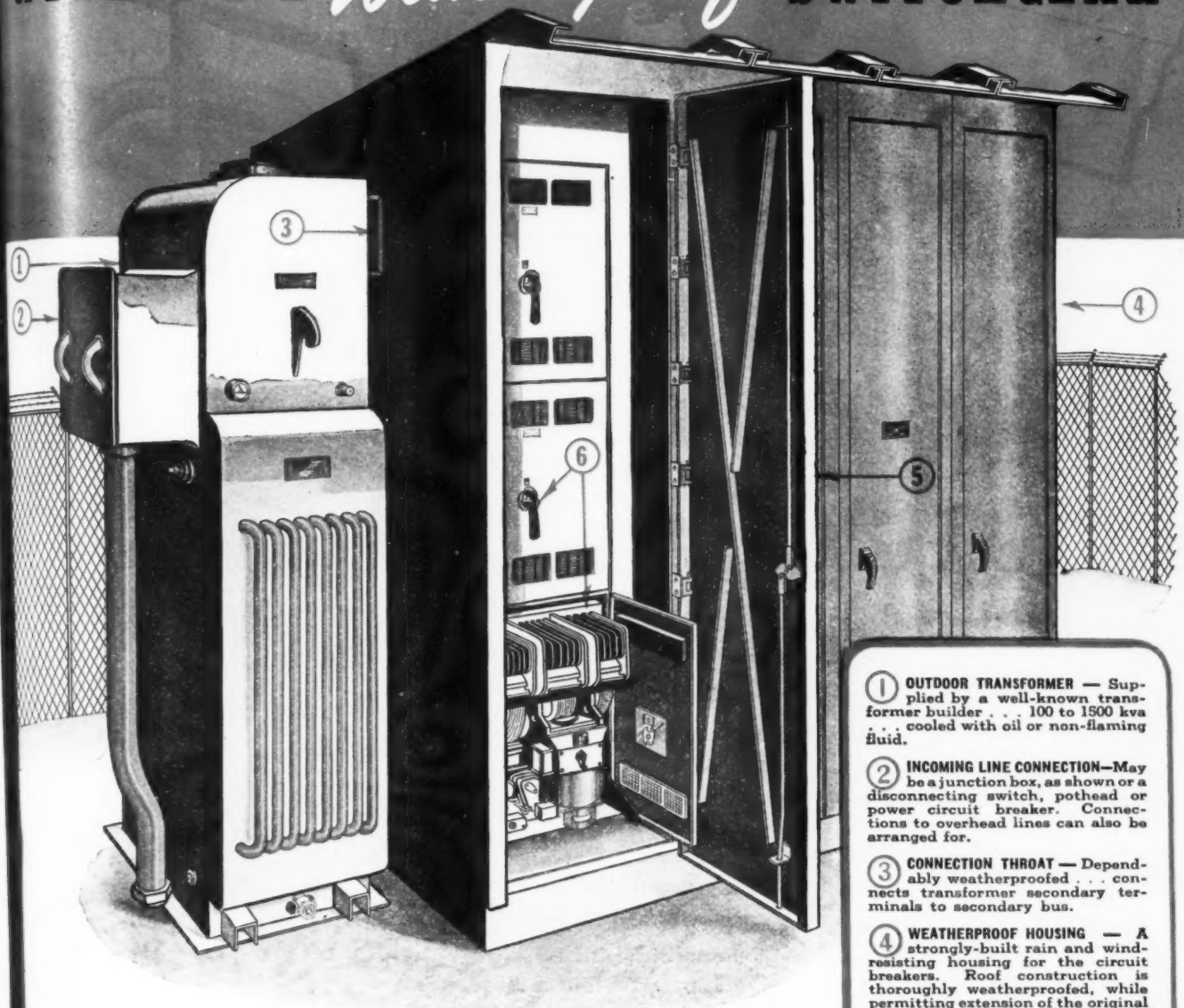

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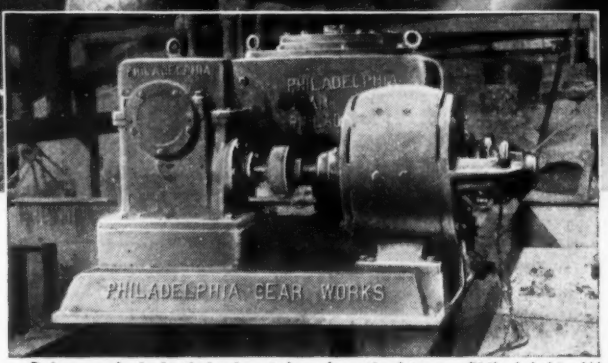

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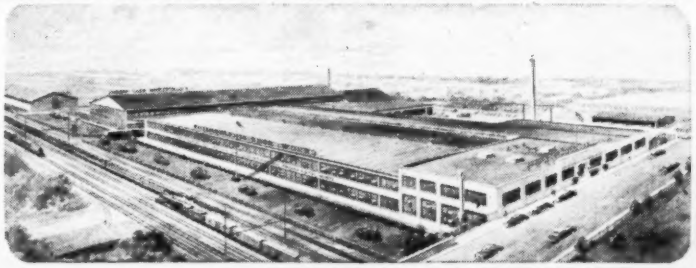

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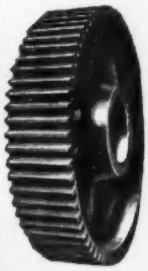

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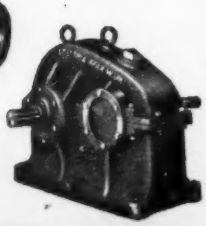

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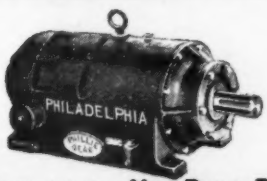

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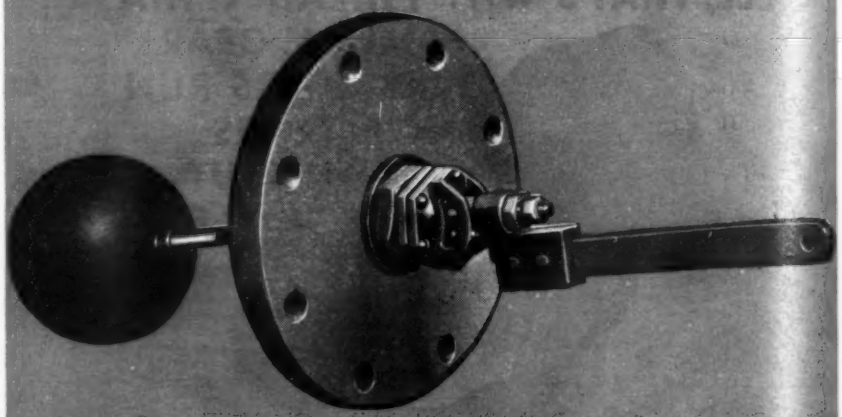

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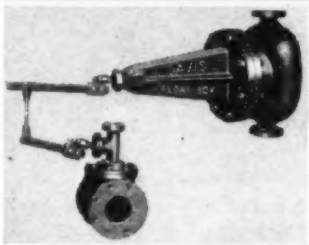

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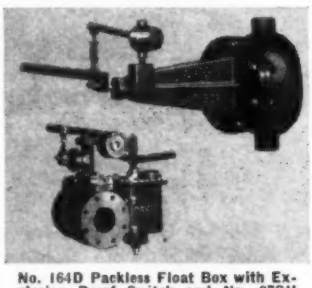

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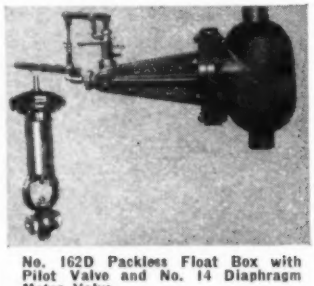

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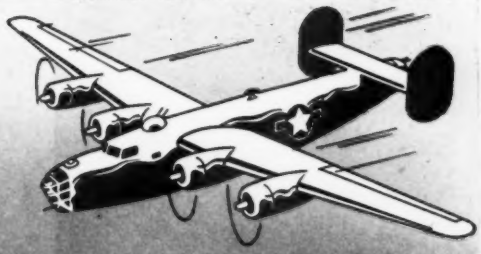

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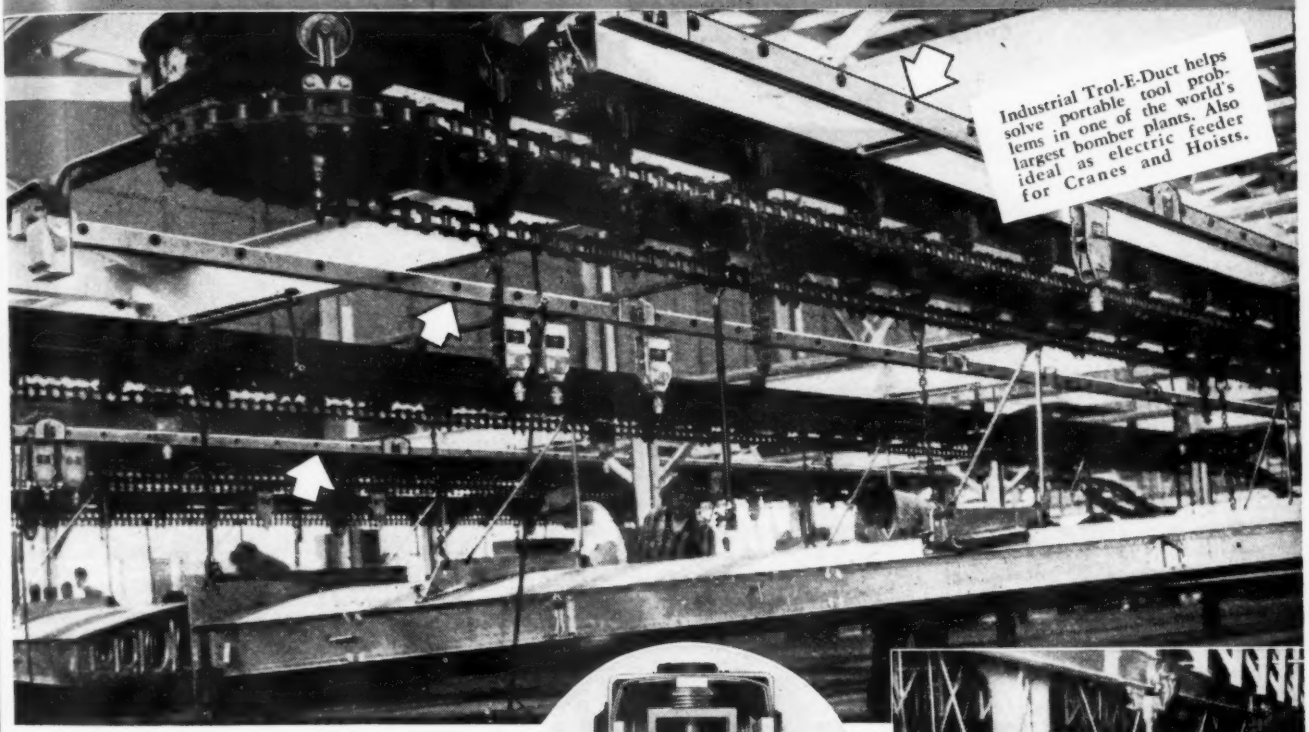

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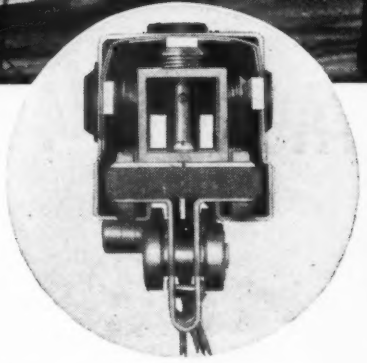

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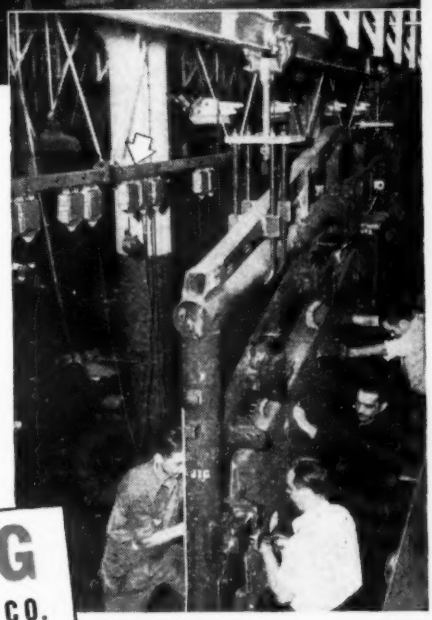

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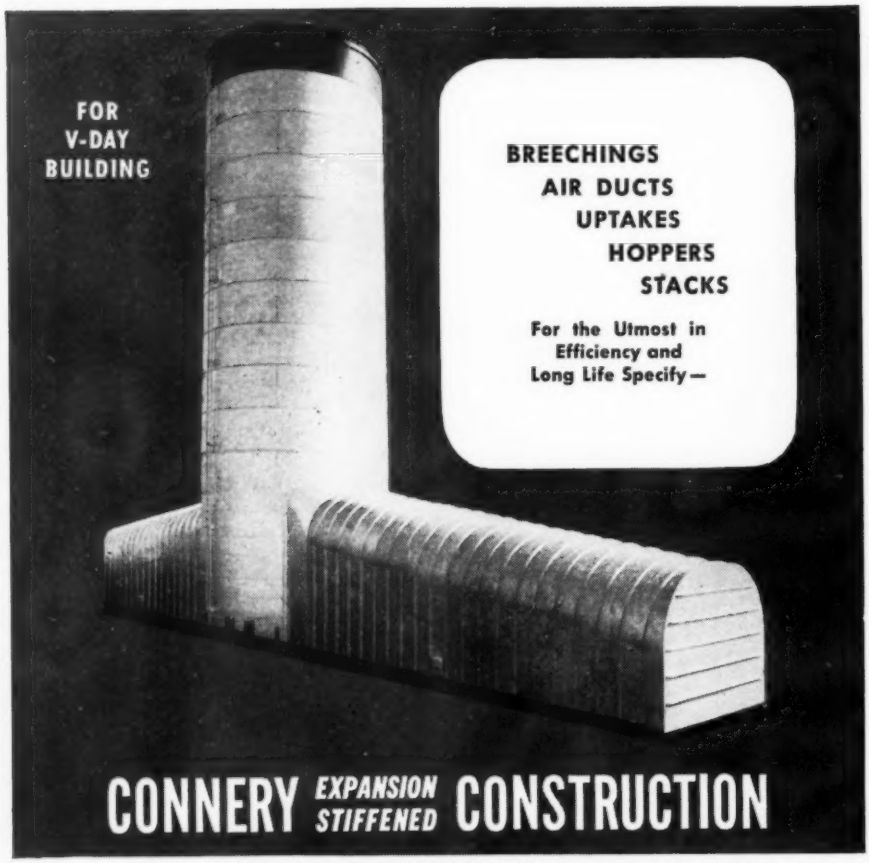

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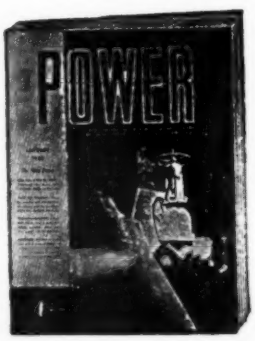

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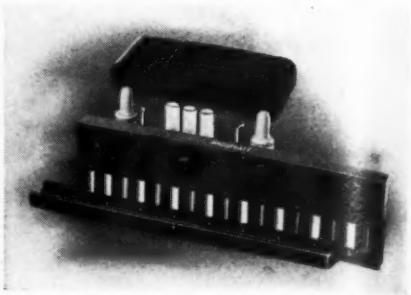

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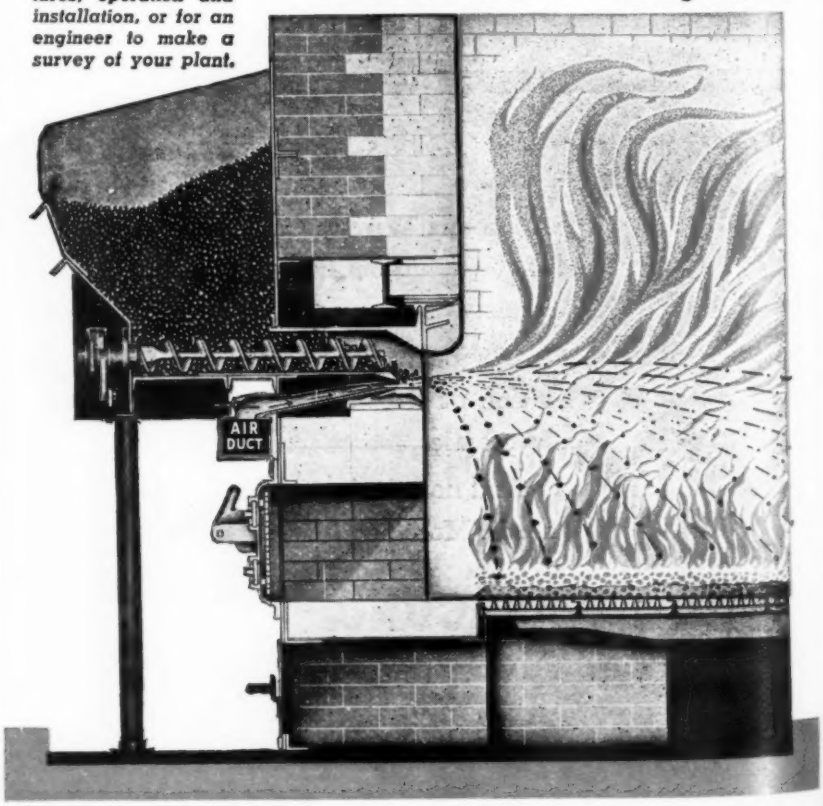

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Ladish Forged Steel Flanges...sizes from ½" through 24" and in pressure ratings ranging from 150 to 2500 p.s.i....serve in power plants everywhere, helping supply the power needed to back the attack.

ARMY E NAVY

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LADISH DROP FORGE CO.

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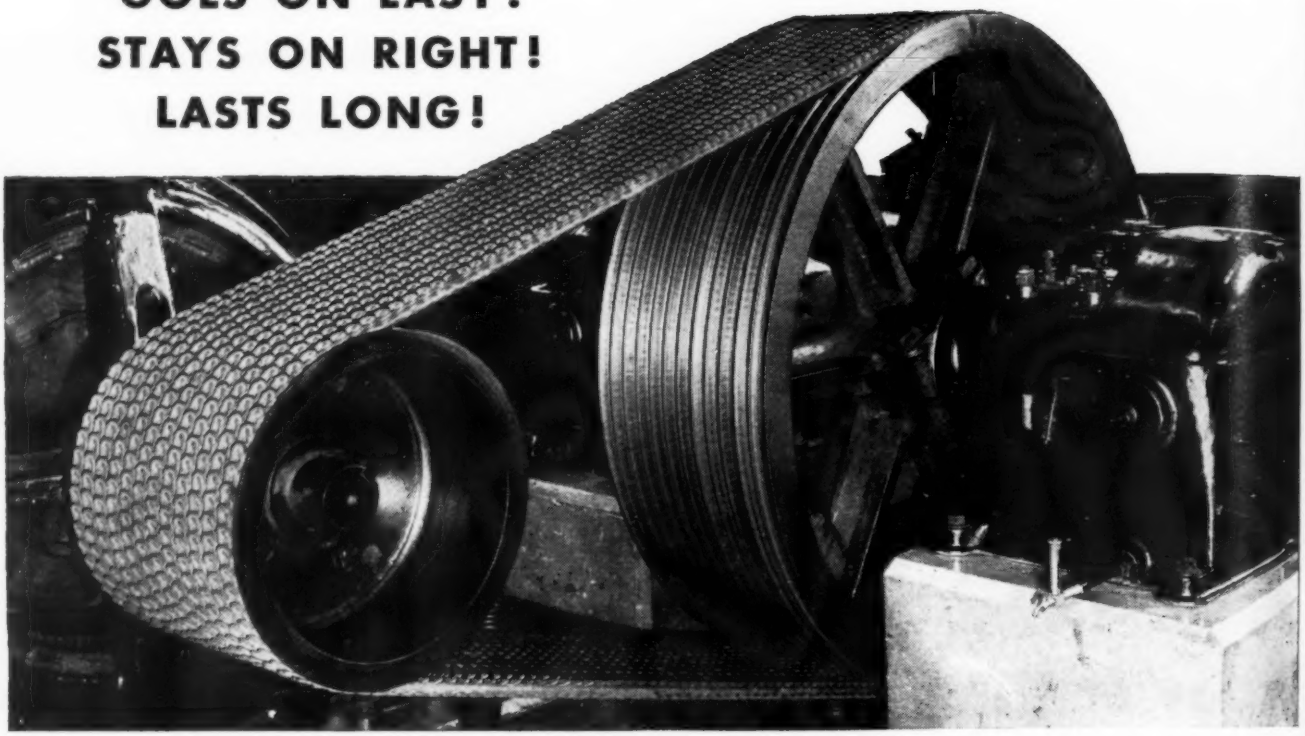
VEELOS...

GOES ON EASY!
STAYS ON RIGHT!
LASTS LONG!



WHAT'S the verdict on Veelos — the adjustable V-belt — by those who know from experience? Here's one! . . . after the 12-strand "E" size Veelos V-drive (shown) had given two years' service on this 250 HP compressor, a second unit was equipped with Veelos. That's just one example of how users "repeat" with this unique V-belt.

Three of the reasons Veelos buyers become Veelos enthusiasts are:

1. Ease of installation: Stock Veelos in economical rolls and, in less than 60 seconds, you can uncouple any desired length! In another 60 seconds, you can couple the belt endless and install it on the drive. Veelos "goes on easy!"

2. Controlled tension: Tension is easy to control on each individual strand of Veelos. That means controlled tension in *the entire drive!* Bearings are protected as well as belts. Veelos "stays on right!"

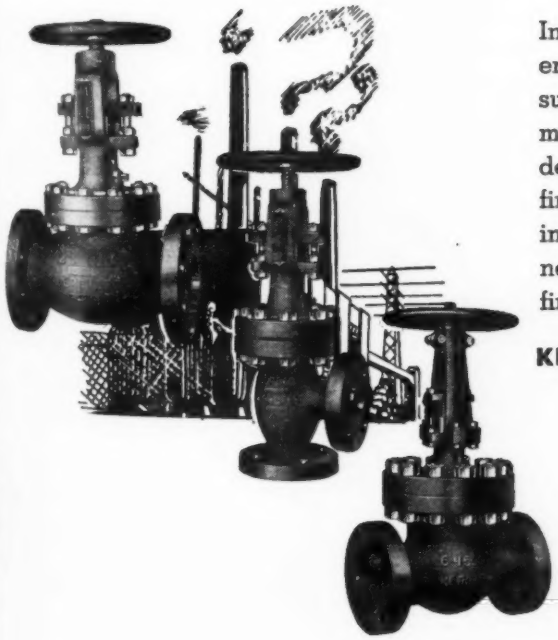
3. Long service: Three Veelos features combine to provide longer belt life. A. The reduction of binding stress by Veelos' extremely flexible laminated construction. B. Uniform distribution of the load on all strands through equalized tension. C. Perfect fit in the groove on all sheave diameters. Veelos "lasts long!"

Write today for *free 8-page illustrated manual* giving Veelos applications, construction detail, installation directions and engineering data.

MANHEIM MANUFACTURING & BELTING CO.
MANHEIM, PENNSYLVANIA

VEELOS
THE LINK
V-BELT
ADJUSTABLE TO ANY LENGTH
ADAPTABLE TO ANY DRIVE

and Kerotest Valves do the job!



Instant, certain and smooth response to emergency needs is an absolute "must" for submarine valves—and every step in Kerotest manufacture of these products perfects their dependability. Our experience in building fine oil field valves helps mightily in producing Marine Valves today . . . just as today's new research and facilities will assure you finer industrial valves tomorrow!

KEROTEST MANUFACTURING COMPANY
PITTSBURGH, PENNSYLVANIA

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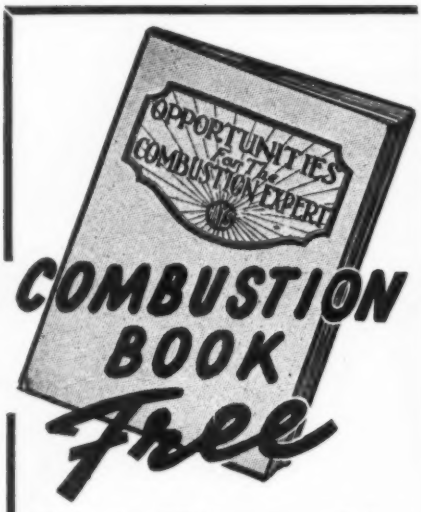

Combustion Efficiency as applied to Boiler Plant Operation, Fuels and Equipment is now a most important factor in Defense work. Fuels cost more than ever before. Boiler loads are heavier. A scarcity of some kinds of fuel is apparent.

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How? Through the simple, easy reading, *practical* Hays Home Study Course in Fuel and Combustion Engineering. For 26 years the Hays Institute has specialized exclusively in training in Combustion Efficiency. Hundreds of Hays trained men now hold substantial positions of responsibility. What we have done for them we can do for you, in your spare time. Many companies urge their men to enroll. They know the value of Hays Combustion Training.

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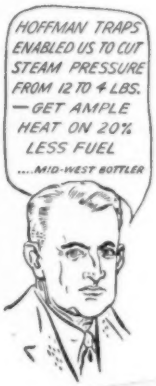
SAVED 6,000 LBS. OF STEAM PER HOUR WITH HOFFMAN TRAPS
SAYS FARM MACHINERY MFGR.



HOFFMAN TRAPS ENABLED US TO CUT STEAM PRESSURE FROM 12 TO 4 LBS. —GET AMPLE HEAT ON 20% LESS FUEL
....MID-WEST BOTTLER

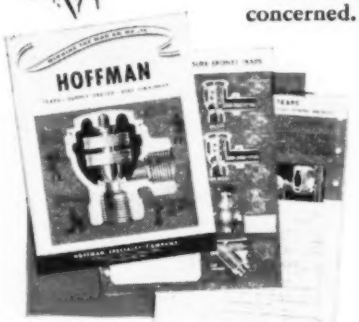
WINNING THE WAR ON WASTE *with* HOFFMAN TRAPS

Waste of fuel at any time is an economic error. Today, with serious shortages hampering production, *it is inexcusable!*

Hoffman Traps, as cited in the above actual cases, are doing a notable job in restoring run-down or antiquated heating plants to greater efficiency—efficiency which means less fuel to produce better results.

Modernization with Hoffman Traps is a good deal for all concerned. The owner makes a reduction in operating cost which each year is equivalent to a profit . . . and the country is benefited by relief from the strain on fuel production and transportation.

For a quarter century, heating engineers have specified Hoffman Steam Specialties . . . because every refinement which adds to performance is included in them—at no greater cost! Hoffman Valves, Traps and Pumps are thus a *quality, time-tested* line of products. It is a complete line, with every specialty needed to equip either new or remodeled heating plants.

Hoffman engineers are always available for consultation. Write for new Trap catalog.

Hoffman Traps are fully described in this booklet of engineering data. Your copy will be sent on request.

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Makers of Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems.
Sold by leading wholesalers of Heating and Plumbing Equipment.

PREHEAT *can Help YOU...*

1 to Improve Combustion
OF LOW-GRADE FUELS

2 to Raise the Level
OF HEAT RECOVERY

3 to Save Materials
IN PLANT DESIGN

Recent applications of Ljungstrom Air Preheaters are doing all three!

AT A MIDWESTERN INDUSTRIAL PLANT, coal with a moisture content exceeding 15% is being successfully pulverized and burned with high efficiency. Ljungstrom Air Preheaters furnish air heated to 500 F to make it possible.

A NEW ENGLAND UTILITY has installed a highly advanced steam generating station, using forced steam circulation, and incorporating two-stage superheater, reheater and economizer. But the final step in high-efficiency heat recovery is left to two Ljungstrom Air Preheaters, which bring stack gases down to less than 300 F.

AN OIL-REFINERY CRACKING FURNACE, designed for a high level of heat economy, saves alloy steel in the convection tube banks by use of a Ljungstrom heater. Gases leaving the furnace at 1300 F are cooled to 580 F, heating combustion air to 1062 F. A more efficient, compact furnace results.

PREHEATER EXPERIENCE which has made these gains possible is available to you or your consultants on any project requiring efficient gas-to-air heat transfer from 300 to 1500 F. Included are industrial applications for synthetic rubber, ore roasting, etc., as well as steam generation.

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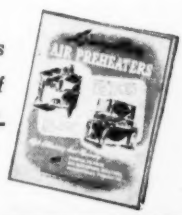
Write today for this booklet. It describes the principle and construction details of Ljungstrom Air Preheaters and the fuel-saving economies it makes possible.



THE AIR PREHEATER CORPORATION
OFFICES: 60 EAST 42nd STREET, NEW YORK 17, N. Y.
PLANT: WELLSVILLE, N. Y.

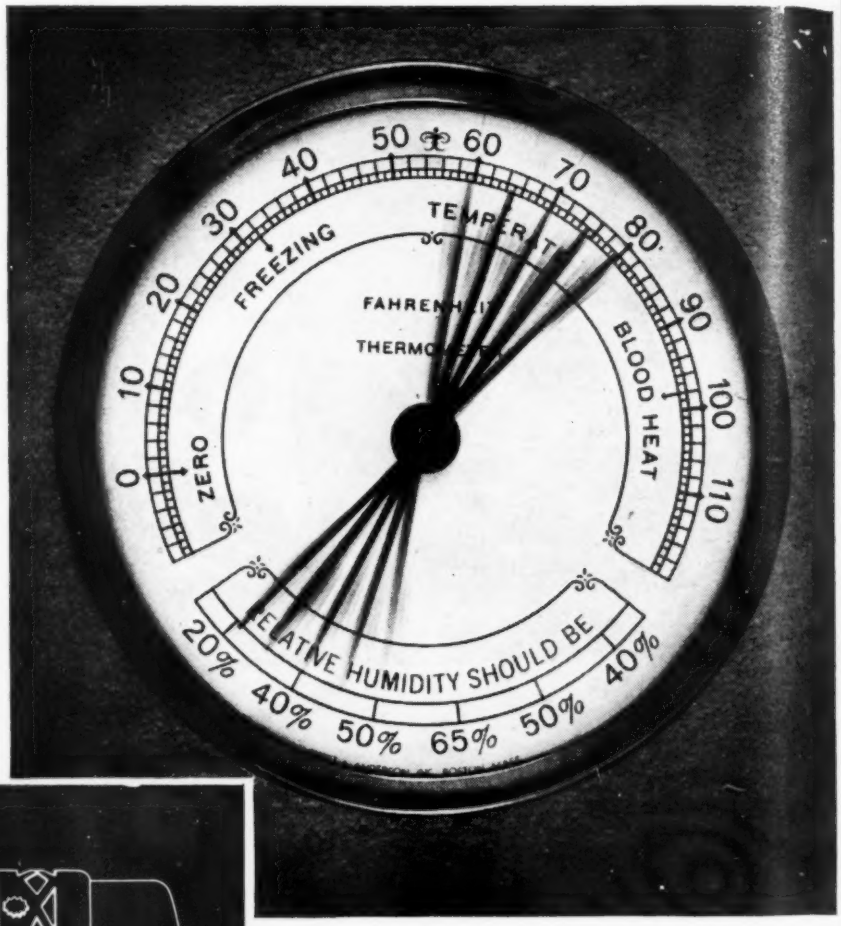
SEDATIVE FOR NERVOUS THERMOMETERS

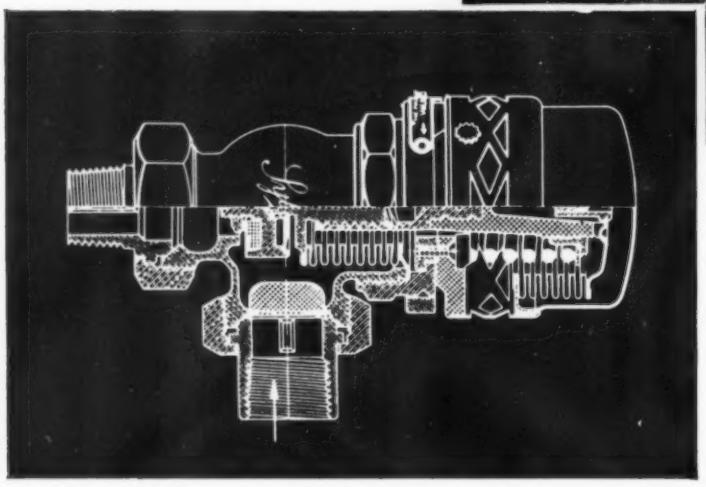
SYLPHON Automatic Radiator Valves *control temperatures.* There are no "chills and fever," because the fully *modulating* action of the integral thermostat immediately compensates for the slightest change in room temperature. No short, sudden "on and off" action . . . instead a continuous regulation of the steam flow to the radiator to maintain a healthful, even temperature.

Fuel economies, comfort and consequent increased efficiency of employees are but a few of the many outstanding advantages of Sylphon Automatic Radiator Valves.

One year's fuel savings often return the cost of a Sylphon Automatic Radiator Valve installation. These valves are sturdily constructed, and incorporate the unique Sylphon packless design . . . normally they last for many years without requiring service.

Send for bulletin SE 255.

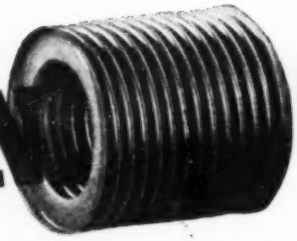




No. 885 Sylphon Automatic Radiator Valve suitable for any two pipe steam, vapor or vacuum system. Designed so that it can be set at desired temperature and locked with a special key, to prevent tampering by unauthorized persons . . . The Fulton Sylphon Co. manufactures a complete line of automatic temperature control devices for heating, piping and air conditioning systems. Send for literature.

TEMPERATURE CONTROLS . . .

FULTON SYLPHON



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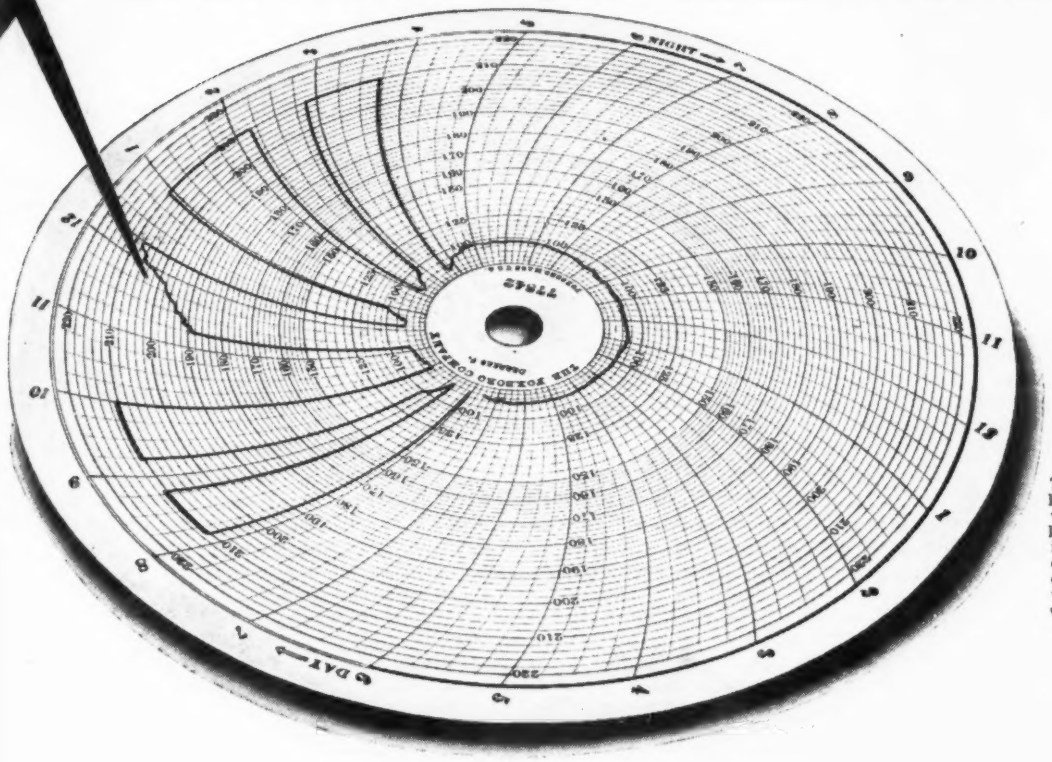
BELLOWS . . . BELLOWS ASSEMBLIES SINCE 1904

THE FULTON SYLPHON CO., KNOXVILLE 4, TENNESSEE

Canadian Representatives, Darling Bros., Montreal

MARKS THE SPOT

where needless production losses occurred!



This chart shows how one batch "went wrong" because of boiler steam failure impossible to control at the process. Without the record, no one would have known why it happened!

Only Controllers that keep Written Records can give such vital facts about your product!

On any process employing temperature controllers, you'll get important *added protection* by installing controllers that keep written records of the temperature!

Foxboro Recording Temperature Controllers not only hold process temperatures exactly where you want them, but give you continuous graphic records to prove it. Even if external factors, such as steam failure or mechanical troubles, should "let you down", these automatic watchmen instantly mark it on the record . . . give you immediate opportunity to check the cause and correct it!

Foxboro On-Off Temperature Controllers are the type that has been proved best for over 65% of all control jobs . . . exactly suited to the characteristics of most processes. Simple, positive-acting, and calibrated in degrees for accurate direct setting.

Install Foxboro Recording Temperature Controllers and get continuous, accurate checks against needless losses. Write for Bulletin 225-2. **The Foxboro Company, 68 Neponset Avenue, Foxboro, Mass., U. S. A.** Also Montreal, Canada. Branches in principal cities.

Foxboro On-Off Temperature Controller—the closest type of control for 65% of all jobs. Other Foxboro Controllers give equally outstanding performance for *special* jobs . . . the other 35%!

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RECORDING TEMPERATURE CONTROLLERS

Make Your Overhead Valves SAFE And Easy to Reach---

With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass.

The COFFIN-Steam Turbine CENTRIFUGAL PUMPS

For Boiler Feed and general high pressure service.

See previous issue for details

THE J. S. COFFIN, JR., Co.
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Stop it with RANAREX*

It's easy to stop wasting power with Ranarex. Just measure the CO_2 in flue gases with this instrument and you can regulate combustion to the exact point at which you get the most power possible from the fuel consumed. You eliminate guesswork, stop wasting fuel. Users report big savings—up to 20%.

Anyone can operate Ranarex. It's so simple it can be taken apart with a screwdriver. It's the only all-mechanical CO_2 indicator and recorder—contains no chemicals or fragile parts to get out of order. Yet it gives almost instant readings, accurate to within 3/10 of 1%.

Get full details about this amazing fuel-saver now! Write to The Permutit Company, Dept. A, 330 W. 42nd St., New York 18, N. Y. In Canada: Permutit Company of Canada, Ltd., Montreal.

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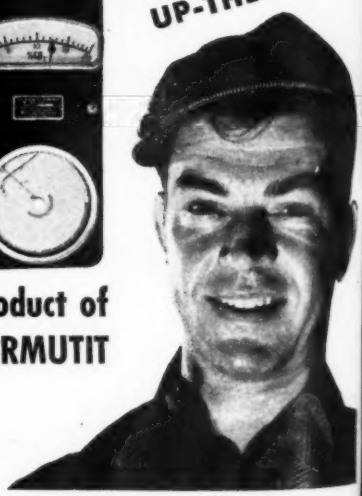
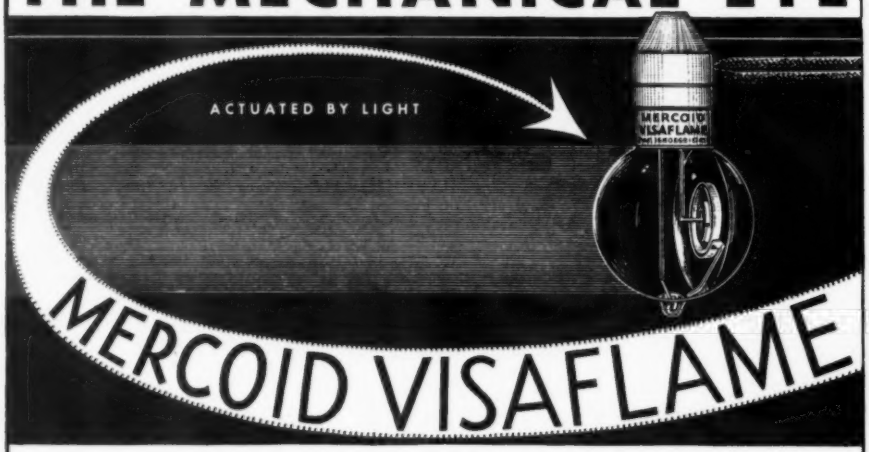
"CUTS HEAT LOSS UP-THE-STACK"



product of PERMUTIT

THE MECHANICAL-EYE



An advanced step, yet a tried and proven safety control system for industrial oil fired heating plants and ovens.

Long before Pearl Harbor, the Mercoid Visaflame has been the guardian of thousands of oil fired heating plants, performing without care or service. These installations are truly appreciated today by the owners who, through manpower shortage, are dependent upon the proper functioning of the automatic control system.

A 100% mercury switch control equipment – the best in every test.

Samples are available for trial.

Our engineers will gladly assist in their proper application.

Further information upon request.

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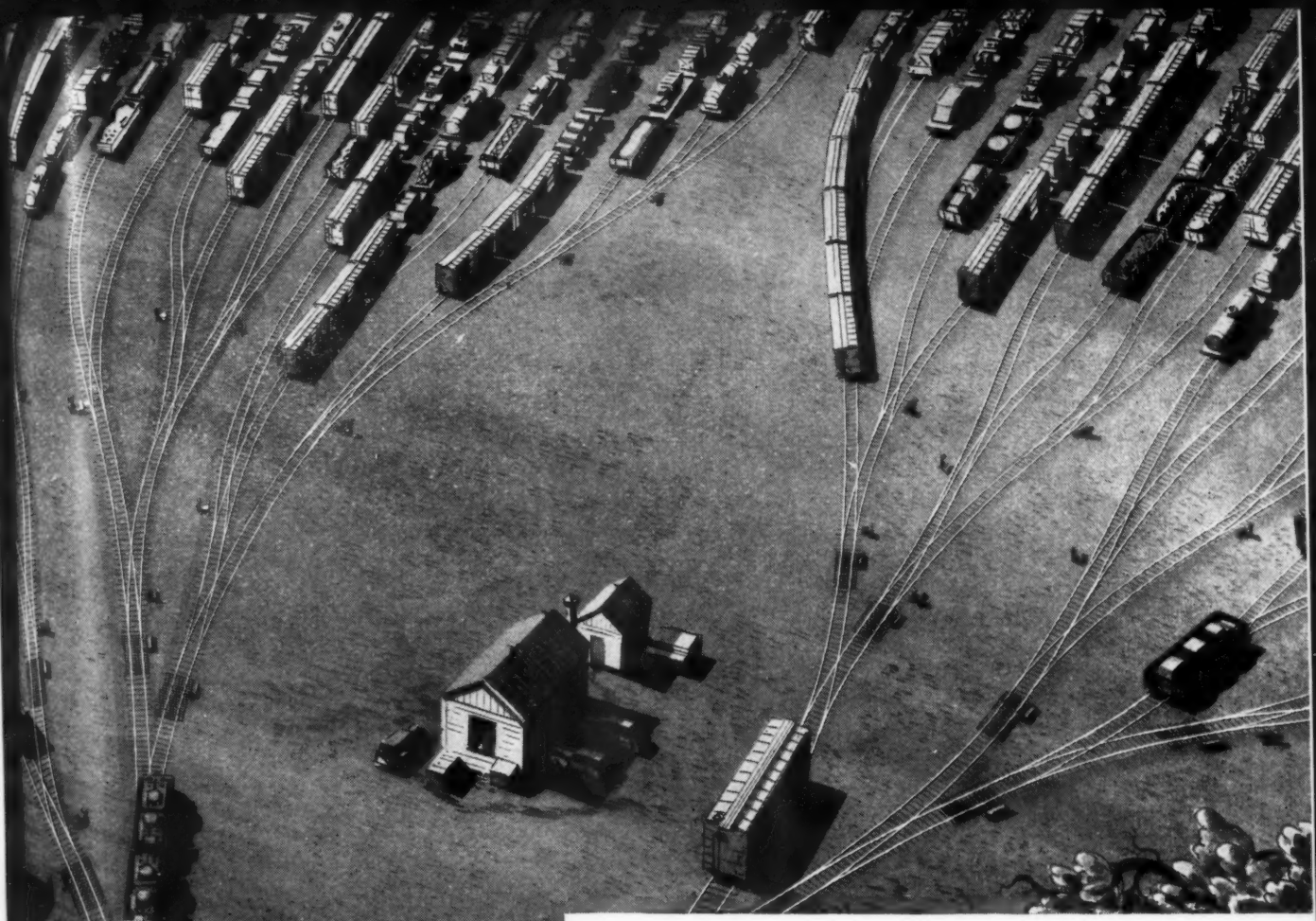

OVER THE HUMP
with war-swollen freight

You are looking at the world's largest classification yard.

Here, 8,000 cars a day, loaded with freight roll down the hump, are sorted and sent on their way to cities and hamlets across the breadth of the land.

These loaded cars rolling downgrade to the classification tracks would gain tremendous momentum were it not for the electrical retarders placed at intervals along the track. These retarders slow up the cars by gripping the wheel flanges with steel fingers.

Here is another job where Foote Bros. gears are working 24 hours a day helping get America's most important job—winning the war—done.

But the sturdy speed reducers—the compact actuators—the extreme precision gears that Foote Bros. are today producing for the Army, the Navy and for industry hold promise to American manufacturers of new efficiencies in the transmission of power made possible by new engineering developments—new manufacturing "know hows" acquired in the stern laboratory of war.

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INDUSTRIAL AND PRECISION GEARS
• SPEED REDUCERS • MOTORIZED
REDUCERS • AIRCRAFT DEVICES

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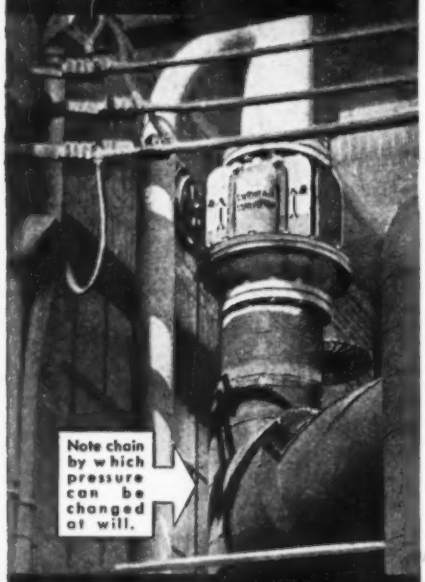
Better Power Transmission Through Better Gears

SAFE!

NO STICKING—NO JAMMING



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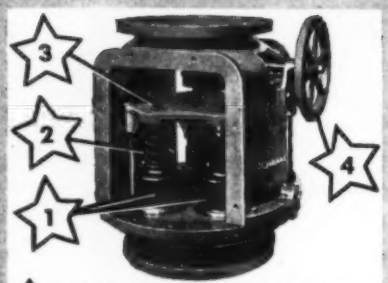
EASILY and QUICKLY



1. Multiple valve disks, instead of one large disk.
2. Individual lifting spindles and hold-down springs.
3. Pressure Plate by which predetermined pressure is adjusted.
4. Adjusting hand wheel. This can be operated by hand, chain or motor.

Write for Publication 2870 for complete data.

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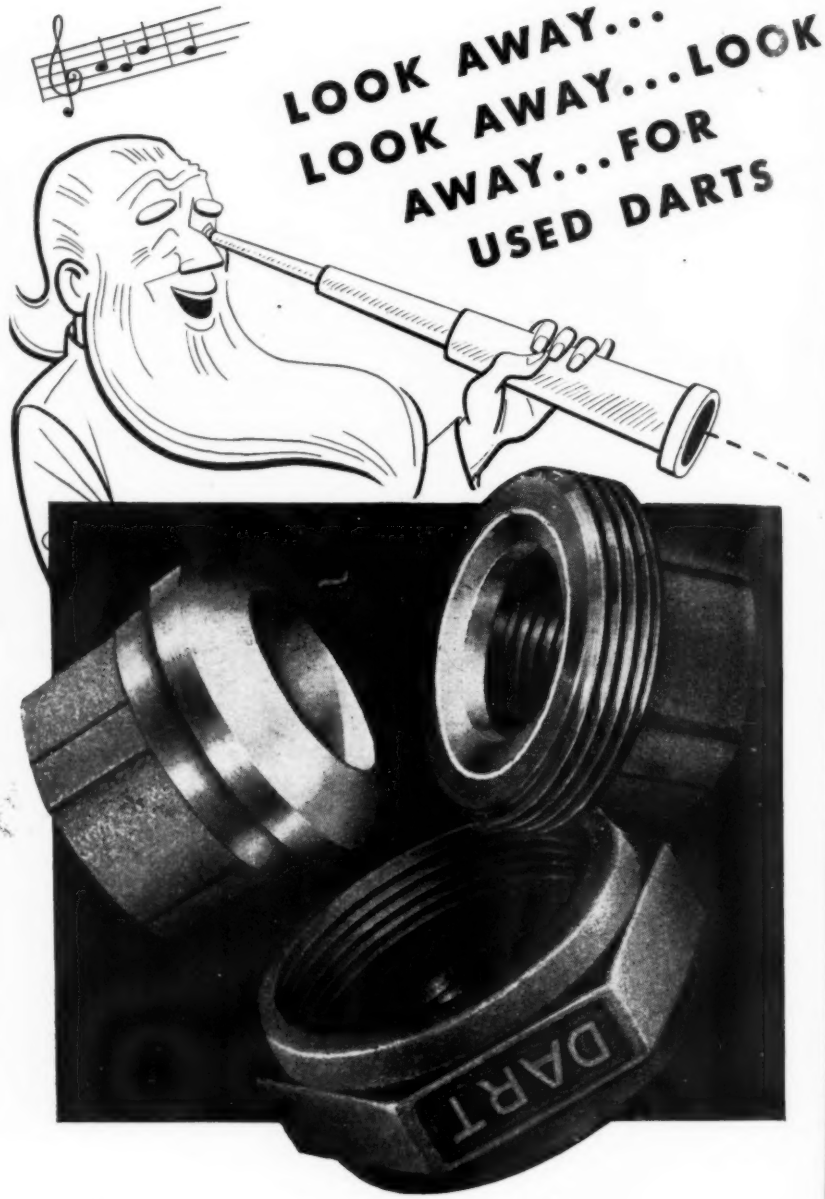
MULTIPORT

RELIEF VALVE



. . For Discarded Dart Unions Can Be Put Back To Work

In plants all over the country the search continues for Dart Unions that have given lots of dependable service and have therefore been retired . . . *yet which have lots of dependable service still to give.*

The explanation of why Dart Unions can provide tight-joint performance *so many times* is found in a Dart's design and construction. Darts have two extra-wide, non-corroding bronze seats, ground to "true-ball" surfaces. And the nuts and bodies of all Dart Unions are made of High-Test Air Refined Malleable Iron that resists pipe strains and rough handling.

DART UNIONS

Keep looking away in your plant buildings and yards for your discarded Darts. Come to your supplier for *new* Darts.

E. M. DART MFG. CO., Providence, R. I.

COTTRELL PROCESS

of

ELECTRICAL PRECIPITATION

universally recognized as a
standard method of removing

DUST, FLY ASH, FUME, MIST & FOG

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30 years of research, development and operating experience throughout the world are incorporated in the

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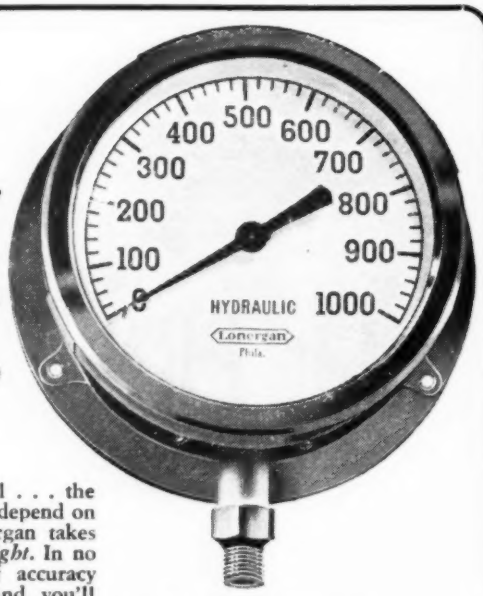
LONERGAN

"Read-Easy" PRECISION GAUGES

Provide for Accurate Pressure Control



Gauge readings are often critical . . . the control engineer must be able to depend on what he sees. That's why Lonergan takes extra pains to build its gauges *right*. In no gauges are higher standards of accuracy and construction maintained. And you'll find a complete range of types from which to make a selection—steam and air gauges, hydraulic gauges, and many other types. As one of the oldest manufacturers of precision gauges, you'll find Lonergan a dependable source of dependable gauges.

"SINCE 1872"

Lonergan

J. E. LONERGAN COMPANY, 2nd & RACE STS., PHILA. 6, PA.

SAFETY VALVES • RELIEF VALVES • PRESSURE GAUGES • SPECIALTIES

What About Lubrication For This VIKING PUMP?
Always keep the Grease Cups Filled With A GOOD GRADE Of Grease!
NUMBER SIX OF A SERIES

How To Get The Most Work Out Of Your VIKING PUMPS

It is absolutely essential that Viking Rotary Pumps be properly lubricated if you are to enjoy the benefit of rugged, dependable service that is built into each and every one of these units. Always use the best grade of grease obtainable for the service involved. Consult your oil company or supply house if in doubt. Or Viking experts here at the plant will be glad to submit definite recommendations if you will write and give us complete data. Remember, please, that grease is cheaper than repairs.

Get *extra* wear out of your Viking Pumps by giving them *extra* care. The Viking Service Manual tells you how. It's a handy, illustrated booklet giving you practical help in mounting, operating and maintaining Viking Pumps. Write for your copy today. It's FREE.

VIKING PUMPS — FIRST IN AMERICA

VIKING *Pump* COMPANY
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Enco OIL BURNERS

have these 7 ADVANTAGES *in pulverized coal fired boilers . . .*

They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

- They warm up cold furnaces
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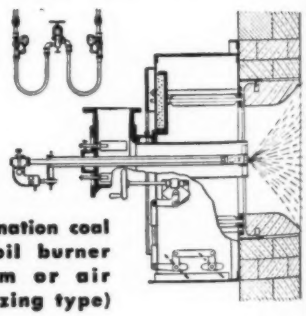
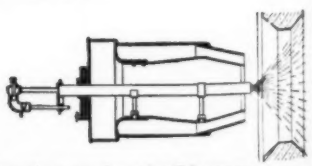
- All capacities of steam, air or mechanical-atomizing types are interchangeable

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 75 West St., New York, N. Y.

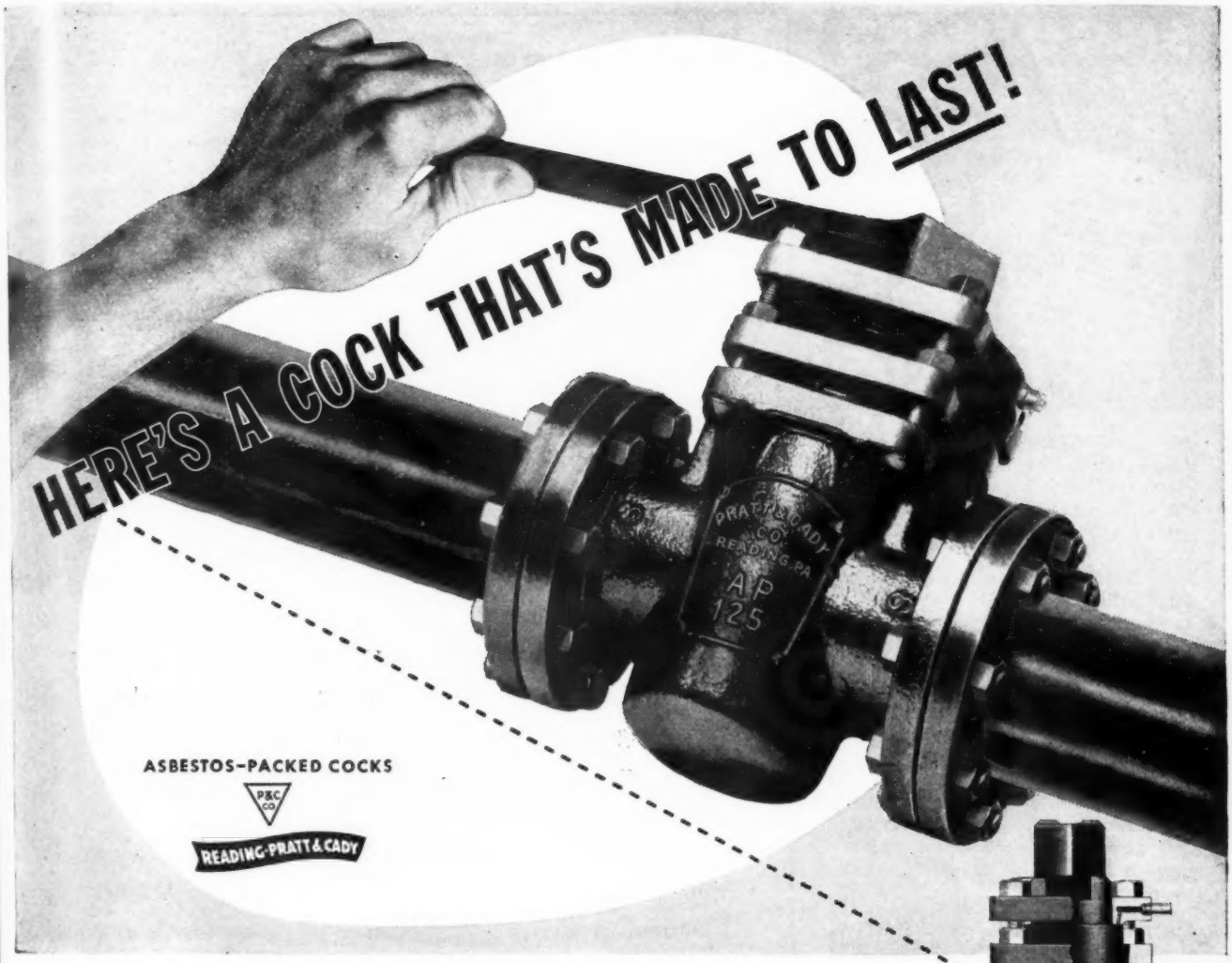


Combination coal and oil burner (Steam or air atomizing type)



Combination coal and oil burner (Mechanical atomizing type)

Enco Burners



The Asbestos Packed Cock is a READING-PRATT & CADY "original"—made to hold a constant, tight seal and give you real service.

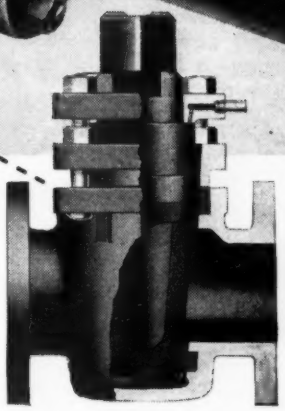
How?..

1. Because of its well-engineered, simple plug, bolted cap design.
2. Because of its asbestos packed U-grooves that:
   a. Provide a tight seal.
   b. Wipe from seating surfaces the foreign matter that other cocks grind in.
   c. Minimize normal friction.
   d. Provide a cushion to absorb the expansion differential between metal of the plug and body.
   e. Can be repacked at the factory, restoring the cocks to good-as-new condition.
3. Because it's made of materials that stand up under services for which they are recommended.
4. The holding down gland design illustrated results in much easier operation and much longer life.

Where?.. for shut-off service on lines that carry:

1. Solids in suspension • 2. Viscous fluids • 3. Oils • 4. Acids and alkalis • 5. Steam, for boiler blow-off

Paper mills, steel mills, packing houses; soap, dye stuffs and by-products plants use this cock in many of their process lines—wherever Globe, Angle or Gate Valves fail or ground cocks prove unsatisfactory. The petroleum industry uses it on gas wells, pipe lines, refinery lines, general "filling" lines, etc. Currently made in cast iron, bronze and cast steel—according to the needs of the service.



Cross section shows the location of the U-groove. Made in either single gland or double gland design. In the double gland design (illustrated) the top gland holds the plug at a pre-determined, constant pressure while the second gland independently compresses gland packing.

READING-PRATT & CADY

MANUFACTURERS OF

READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Denver, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco

A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT • CONNECTICUT

SMOOTH-ON REPAIR RECORDS

Cracked Triplex Pump

A patch plate was shaped to match the curvature of the pump block in order to reinforce the SMOOTH-ON repair. The edges of the crack were then slightly beveled, the surface was cleaned, and a putty of SMOOTH-ON No. 1 was forced into the crack by tamping with a hammer. After the patch was attached to the pump block by machine screws, the repair was completed.

FOLLOW THIS SERIES OF SMOOTH-ON SAVINGS

Many SMOOTH-ON repairs are even simpler than this, for short cracks or cracks which are not under pressure do not require reinforcement when repaired with SMOOTH-ON No. 1. And SMOOTH-ON does not require the application of heat or dismantling of apparatus, so that repairs made with SMOOTH-ON are frequently quicker and more economical than by any other means. SMOOTH-ON repairs are durable, too, as has been proven by literally hundreds of thousands of repairs to plant equipment which have been accomplished by SMOOTH-ON. For stopping leaks, sealing cracks, and tightening loose parts, think first of SMOOTH-ON . . . and keep a can handy.

Buy SMOOTH-ON in 7-oz., 1-lb., or larger containers from your supply house, or if necessary, from us. For your protection, insist on SMOOTH-ON, used by engineers and repair men for over 45 years.

FREE
REPAIR HANDBOOK SHOWS HOW

40 Pages, 170 diagrams, and simple concise instructions for practical repairs to plant equipment, pipe lines and structures. A necessity in every plant. Your copy sent FREE if you fill in and return the coupon.

SMOOTH-ON MFG. CO., Dept. 30
570 Communipaw Ave., Jersey City 4, N. J.
Please send SMOOTH-ON HANDBOOK

Name .....

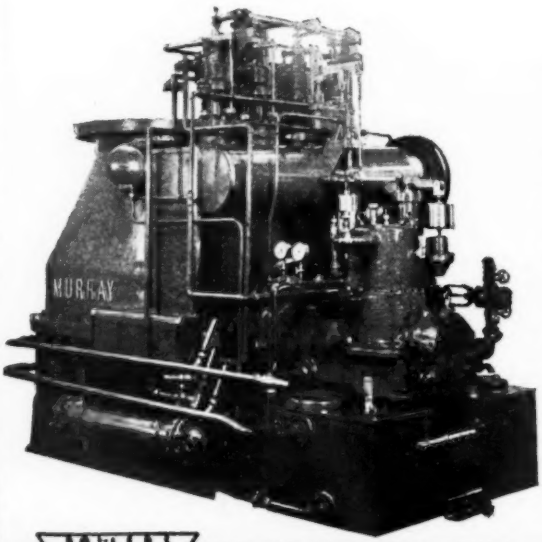
Address .....

3-44

Do it with
SMOOTH-ON

MURRAY TURBINES
for Air Conditioning Compressor Drive

THE illustration below shows one of many MURRAY Turbines designed especially for air conditioning compressor drive. This unit develops 1000 h. p. at 4# initial pressure, 26" vacuum and 4100 r. p. m. It is equipped with variable speed, oil pump, oil relay governor; automatic nozzle control; auxiliary turbine driven starting oil pump; vacuum breaker actuated by overspeed governor; solenoid trip to stop turbine in case of abnormalities in the refrigeration system. Governor includes automatic control which maintains even temperature of the system's cooling medium by varying the capacity of the compressor through the speed. Steam inlet is 12" and exhaust outlet is 36" arranged in an upward direction. Other MURRAY Turbines are driving air conditioning compressor at 8000 r. p. m. or have extraction or extraction mixed pressure gear to maintain the proper heat balance in the plant.



This organization has occupied a prominent place in the steam power equipment field for nearly three-quarters of a century. Thousands of MURRAY Turbines, Engines, and boilers serving throughout the world reflect the skill that goes into them.

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

New *Efficiency* for old condensers

TODAY'S REQUIREMENTS are for *higher* water velocities — *higher* temperatures — *higher* pressures—heavily increasing burdens on condenser tubes. JOHN CRANE CONDENSER PACKINGS are engineered for *duties now, and in the future.* You will find that the *most efficient* condensers have John Crane CONDENSER PACKING . . . used on hundreds of ships and stationary installations.

THESE ARE THE ADVANTAGES

- Easy to install—no special tools required
- Permit quick renewals of tubes in operation
- Reduce cost of retubing and repacking
- Bond tubes to sheets, reducing electrolytic action
- No deformation of tube ends, as by ferrule pressure
- Eliminate costly ferrules
- Permit free expansion and contraction of tubes in temperature changes
- Seal tubes tightly in all heat transfer equipment
- Outlast life of tubes
- Not affected by contaminated or chemically treated water

Remarkable progress has been made in condenser efficiency, and the Crane Packing Company has pioneered every improved condenser packing development. Write for this story and descriptive literature.

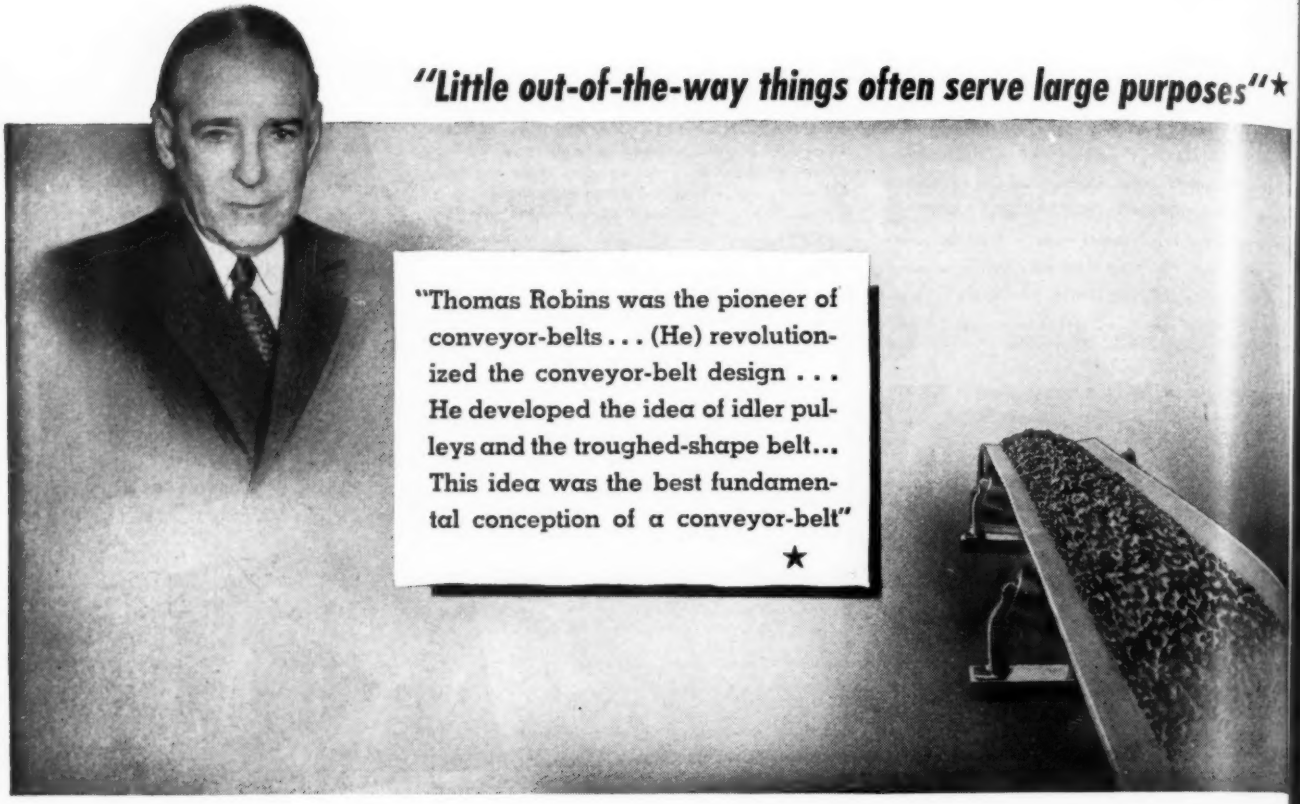
John CRANE
METALLIC CONDENSER TUBE PACKING

FOR OLD AND NEW CONDENSERS

CRANE PACKING COMPANY, 1811 CUYLER AVE. • CHICAGO 13, ILL.

BRANCHES: Baltimore, Boston, Buffalo, Cleveland, Dallas, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Seattle, Tulsa. *IN CANADA:* CRANE PACKING COMPANY, LTD., Hamilton, Ontario, with branches at Vancouver, Toronto and Montreal.

"Little out-of-the-way things often serve large purposes"★



"Thomas Robins was the pioneer of conveyor-belts . . . (He) revolutionized the conveyor-belt design . . . He developed the idea of idler pulleys and the troughed-shape belt... This idea was the best fundamental conception of a conveyor-belt" ★

WHEN THOMAS ROBINS introduced the rubber-covered, trough-shaped Conveyor Belt in 1891, it proved to be the opening of a new industrial era. Before the Belt Conveyor, quantities of raw materials—in mines, quarries, gas and cement plants—were handled in hundreds of tons per day. But with this invention, plants were erected which produced thousands of tons per hour.

When it was cumbersome and costly to handle materials, only the highest grade ores were mined. With the advent of the Belt Conveyor, it became possible and economical to utilize the low grade ores as well. Other minerals and materials which could not be handled by any other means became useful additions to the industrial economy.

With the Belt Conveyor, a single plant produces 1,000,000 tons of washed and sized limestone a month; a coke plant stores and handles 1,000 tons of coal an hour; a shipping pier unloads 6,000 tons an hour; a collier puts ashore her 10,000 ton cargo in five hours with only three attendants—and no shore-based equipment.

Without the Belt Conveyor, mass production might never have been achieved. Without Robins and its pioneering ingenuity—which created 41 "firsts" in a single decade—many materials handling problems might still remain unsolved. Solving difficult materials handling problems has been a Robins habit for half a century. Perhaps you face one now. Submit the facts to Dept. P-3 for an impartial, non-obligating analysis.

** Reprinted by permission from "The Reign of Rubber" by Wm. C. Geer, copyrighted by The D. Appleton-Century Co.*

ENGINEERS • MANUFACTURERS • ERECTORS

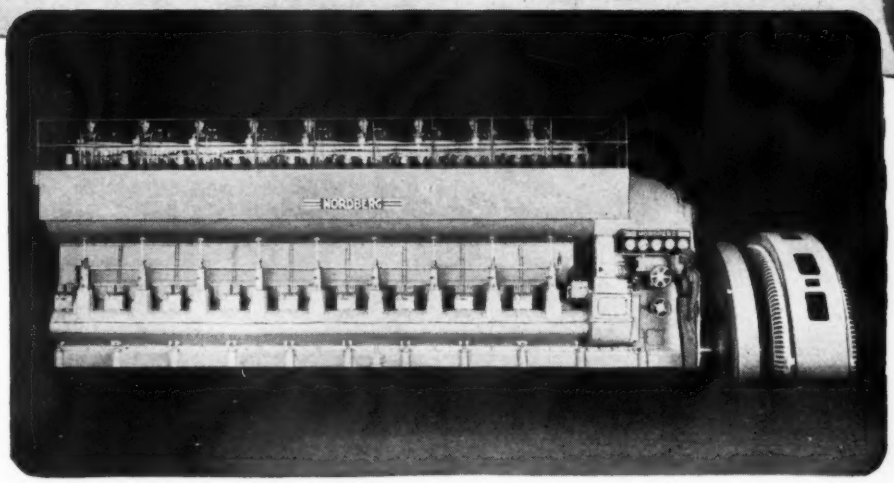
ROBINS *makes:* BELT CONVEYORS • COAL AND ORE BRIDGES • BUCKET ELEVATORS • CAR AND BARGE HAULS • CAR DUMPERS • CAR RETARDERS • CASTINGS • CHUTES • CONVEYOR IDLERS AND PULLEYS • CRUSHERS • FEEDERS • FOUNDRY SHAKEOUTS • GATES • GEARS • GRAB BUCKETS • PIVOTED BUCKET CONVEYORS • VIBRATING SCREENS • SCREEN CLOTH • SELF-UNLOADING BOAT MECHANISMS • SKIP HOISTS • STORAGE AND RECLAIMING MACHINES AND SYSTEMS • TAKEUPS • LOADING AND UNLOADING TOWERS • TRIPPERS • WEIGH LARRIES • WINCHES • WINDLASSES

ROBINS
CONVEYORS
INCORPORATED
Founded in 1896 as Robins Conveying Belt Co.
PASSAIC • NEW JERSEY

FOR MATERIAL AID IN MATERIALS HANDLING . . . . . It's **ROBINS**

MATERIALS HANDLING MACHINERY

Make those Power Plans NOW



This 3600 H. P. unit is typical of the many large Nordberg Diesels which have been installed to provide wartime power.

Many Nordberg Diesels have gone to war. Had they not been required in the war effort, they would have been available for central stations, municipal and industrial power plants. To those in need of additional power in the postwar period, now is the time to plan for that future installation when Nordberg Diesels will again be available. A Nordberg engineer will gladly go over your plan.

NORDBERG MFG. CO., MILWAUKEE 7, WIS.

NORDBERG
DIESEL ENGINES

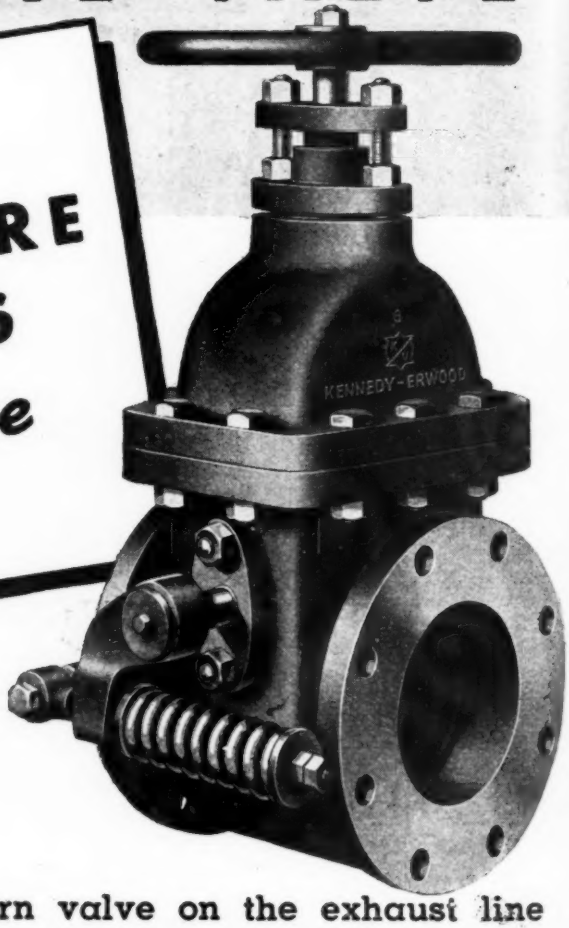
KENNEDY -ERWOOD

SWING GATE VALVE

Protects

LOW PRESSURE APPARATUS

from excessive pressure



Combines the functions of a gate valve, check valve and relief valve in a single unit.

Used extensively as a non-return valve on the exhaust line between turbines or engines and condensers or heaters to protect low pressure casings and cylinders against building up of pressure which might cause failure and severe damage to equipment or injury to operatives. Folder on request, explains other applications as a back pressure valve, atmospheric relief valve or safety valve on pumps, compressors, etc.

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

TO THE OPERATING MAN

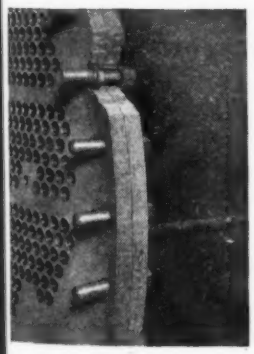
ROSS SURFACE CONDENSERS

MEAN EASE AND CONVENIENCE

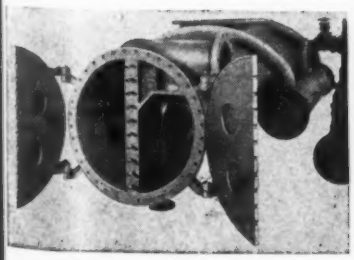
The careful attention given to construction details of Ross Surface Condensers, is familiar to operating personnel in power plants throughout the world.

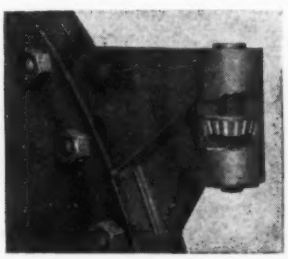
Men who have operated and serviced these units appreciate that the "Ross" label means *—ease and convenience.*

In other words, Ross construction includes more than sound, basic engineering for outstanding performance. It takes into consideration the man who must operate these units. Through certain construction refinements and features (highlighted on this page), therefore, he saves many hours in his job of operation and maintenance.

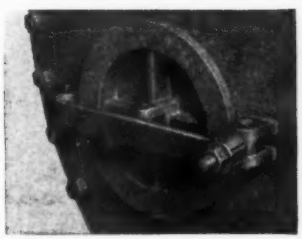


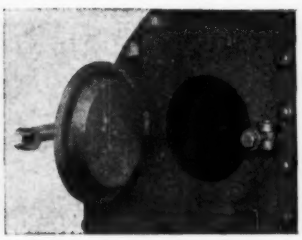
COLLAR BOLTS—Use of a sufficient number of collar bolts, holding the tube sheet securely to the shell flange, permits the removal of water box for free access to the tube sheet and tube ends *without breaking the seal behind the tube sheet.*





WATER BOX COVERS—Mounted on hinges equipped with Timken Bearings. Self-aligning. Require no special tools to open or close—only a wrench.





INSPECTION PORTS—Permit quick examination of tube sheets and tube ends, without need of opening entire cover. Port covers are quick-opening.

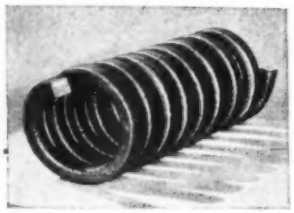
** "Surface Condenser design and Operating Characteristics," a 52-page paper by Townsend Tinker, Chief Engineer of Ross, clearly sets forth the sound engineering principals on which the success of Ross Condensers is based. Copies mailed on request.*

ROSS HEATER & MFG. CO., INC.

Division of American Radiator & Standard Sanitary Corporation

GENERAL OFFICES AND PLANT • 1415 WEST AVE., BUFFALO 13, N. Y.

Win the War in Forty-Four!



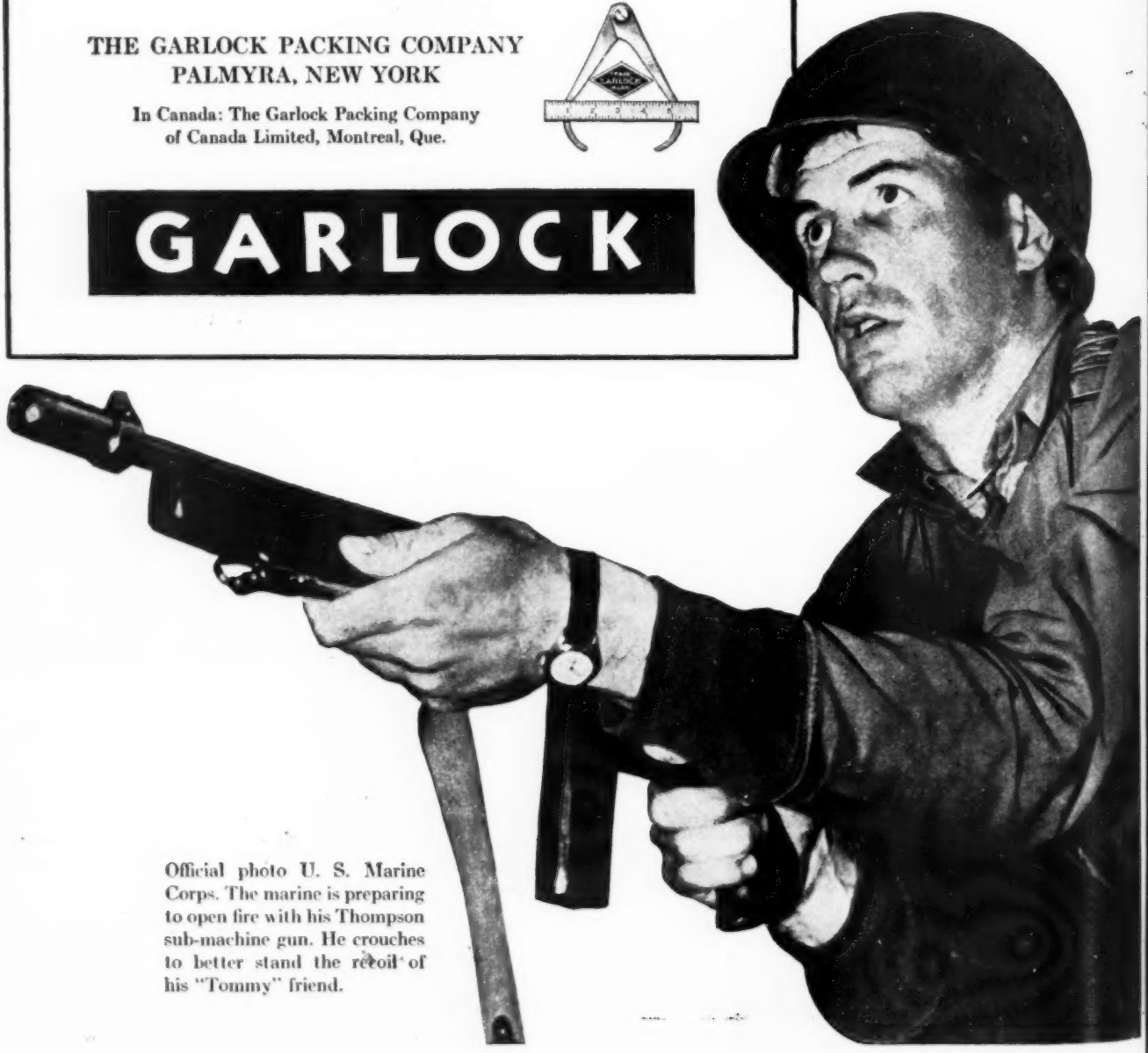
GARLOCK 130 Rod Packing for High Pressure Steam (Spiral form). Coil form—GARLOCK 125. Ring form—GARLOCK 200.

Every day we are producing tons of GARLOCK Packings, Gaskets and KLOZURE Oil Seals for the U.S. Armed Forces and War Industries. Their dependable performance will help the effort of the United Nations to *win the war in '44*. Essential civilian industries are also being supplied with GARLOCK products to the limit of our capacity.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

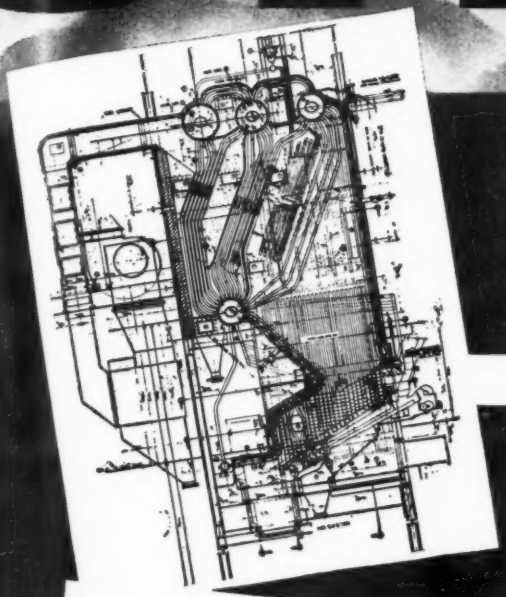
In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

GARLOCK



Official photo U. S. Marine Corps. The marine is preparing to open fire with his Thompson sub-machine gun. He crouches to better stand the recoil of his "Tommy" friend.

STEAM for

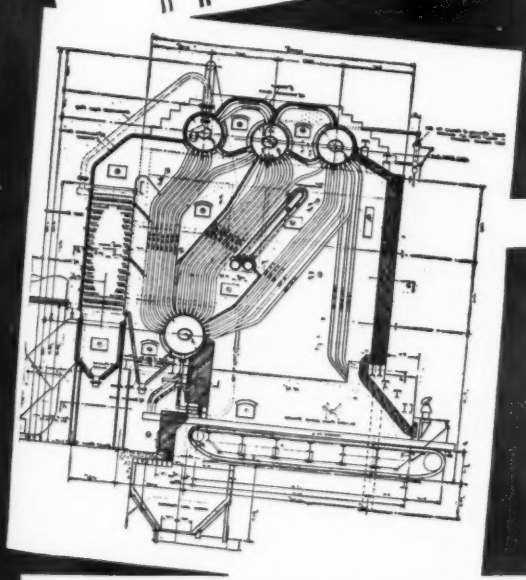


POWER

SOUTHERN COLORADO POWER COMPANY
Pueblo, Colo.

90,000 lbs. steam per hour Vogt LE type bent tube boiler with underfeed stoker. Water walls and economizer. Design pressure 525 lbs. Total steam temperature 750 degrees F.

•

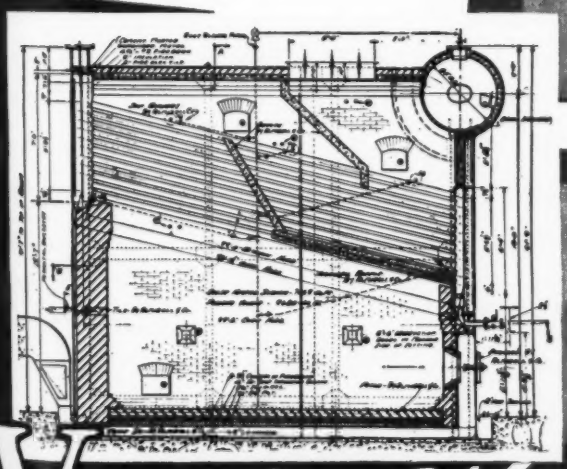


PROCESS

IN A LARGE MID-WESTERN STEEL MILL

Two 105,000 lbs. steam per hour Vogt LE type bent tube boilers with chain grate stokers and economizers. Design pressure 225 lbs. Total steam temperature 550 degrees F.

•



HEATING

CRIMINAL COURTS BUILDING AND JAIL
New York City

Four Vogt sectional header type boilers of 47,000 lbs. steam per hour capacity, oil fired. Design pressure 200 lbs.

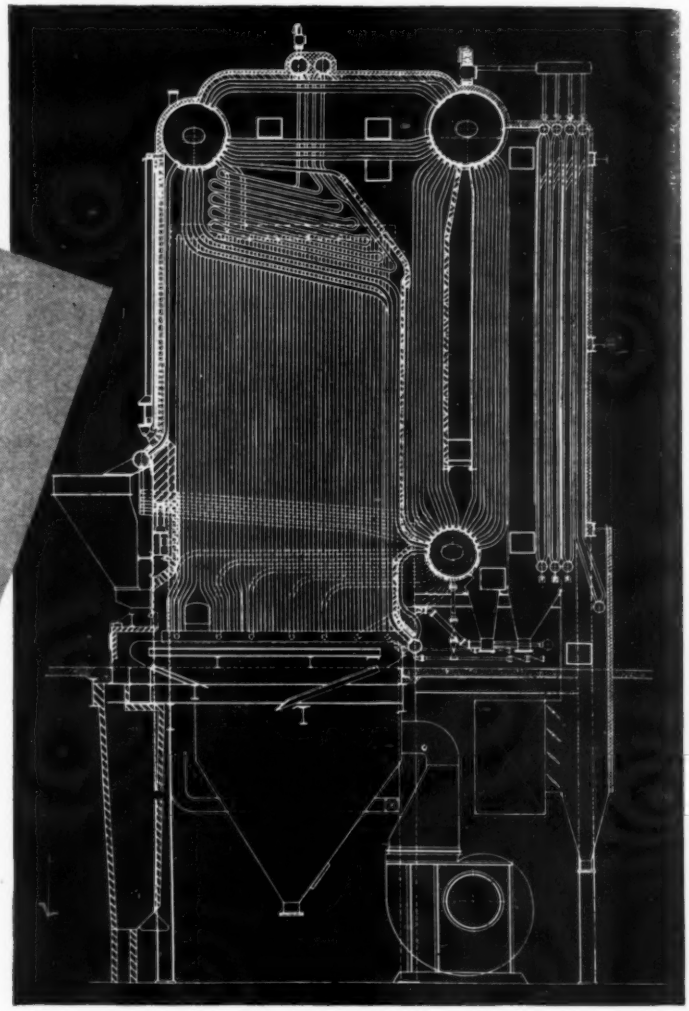
HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY
Branch Offices: NEW YORK CLEVELAND
CHICAGO PHILADELPHIA TULSA

Vogt Water Tube BOILERS

BENT TUBE AND SECTIONAL HEADER TYPES

EDGE MOOR WATER TUBE BOILERS

Edge Moor RADIANT HEAT PERFORMANCE available to You



The Edge Moor radiant heat unit illustrated is designed for a maximum evaporation of 120,000 pounds per hour with a drum pressure of 500 pounds and at 800° final steam temperature. In service at a mid-western central station, it has delivered up to 150,000 pounds of steam per hour. The design takes full advantage of water walls, superheater and economizer. Low grade bituminous coal is fired on a spreader stoker.

This and many other Edge Moor units —in a wide range of types, capacities, pressures and accessory equipment—can be duplicated by Edge Moor with worthwhile savings in time. Our fabricating facilities are geared to go into production promptly on your requirements.

STEAM GENERATING EQUIPMENT

BRANCH OFFICES: NEW YORK CITY: 30 ROCKEFELLER PLAZA
CHICAGO: ONE NORTH LA SALLE STREET

EDGE MOOR IRON WORKS, INC.

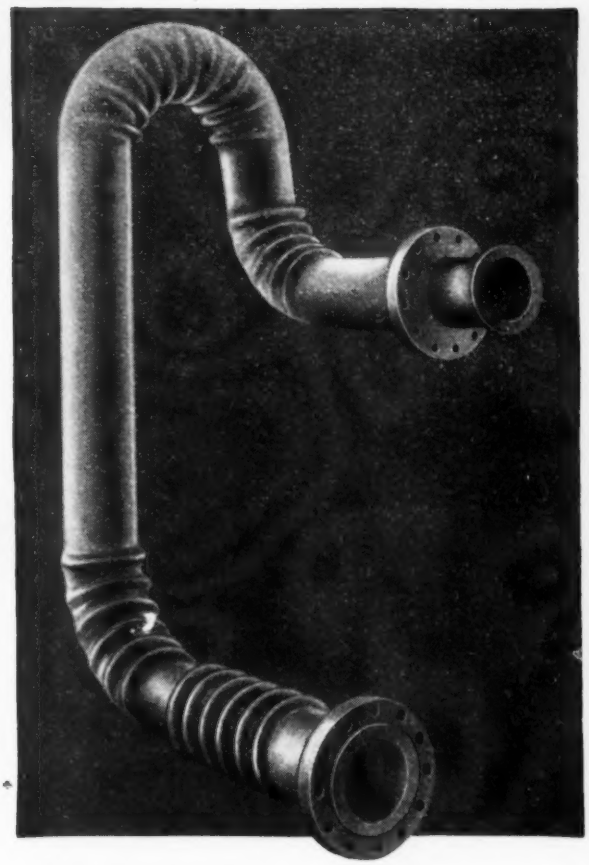
MAIN OFFICE: EDGE MOOR, DELAWARE

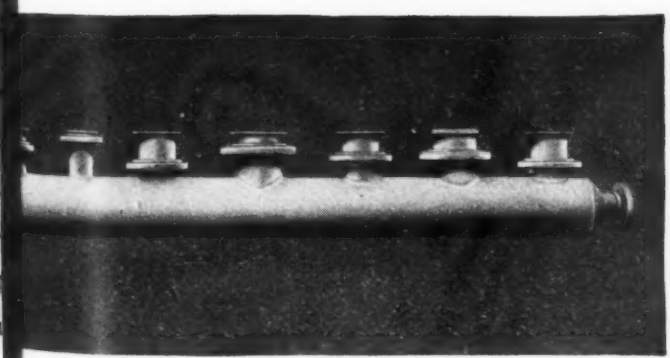
Simplify Installation and Replacement Problems

Specify **PITTSBURGH PIPING AND EQUIPMENT CO.**

VAN STONE LAPPED JOINTS

SIMPLY SLIP IN THE GASKET . . .
INSERT THE BOLTS . . .
PULL UP ON THE NUTS . .
IT'S AS EASY AS THAT!





PITTSBURGH Piping & Equipment Company have complete facilities for Van Stoning high temperature, high pressure, and process piping, of every type and dimension.

Regardless of size, shape, or formation of piping, Pittsburgh Piping & Equipment Company's long experience and precise pre-fabrication methods assure accurate alignment of Van Stone lapped ends. The moveable flanges permit quick, easy lining up of bolt holes and assembling is, therefore, extremely simple. This type of construction is particularly desirable when proper welding facilities are not available in the field.

The use of Pittsburgh Piping & Equipment Company Van Stone Joints also permit speedy removal and replacement of auxiliary equipment, or piping sections, should inspection or replacement become necessary.

Consider the advantages of using Van Stone Joints when planning additions, alterations, or replacements. For further information, contact our nearest representative or write us direct.

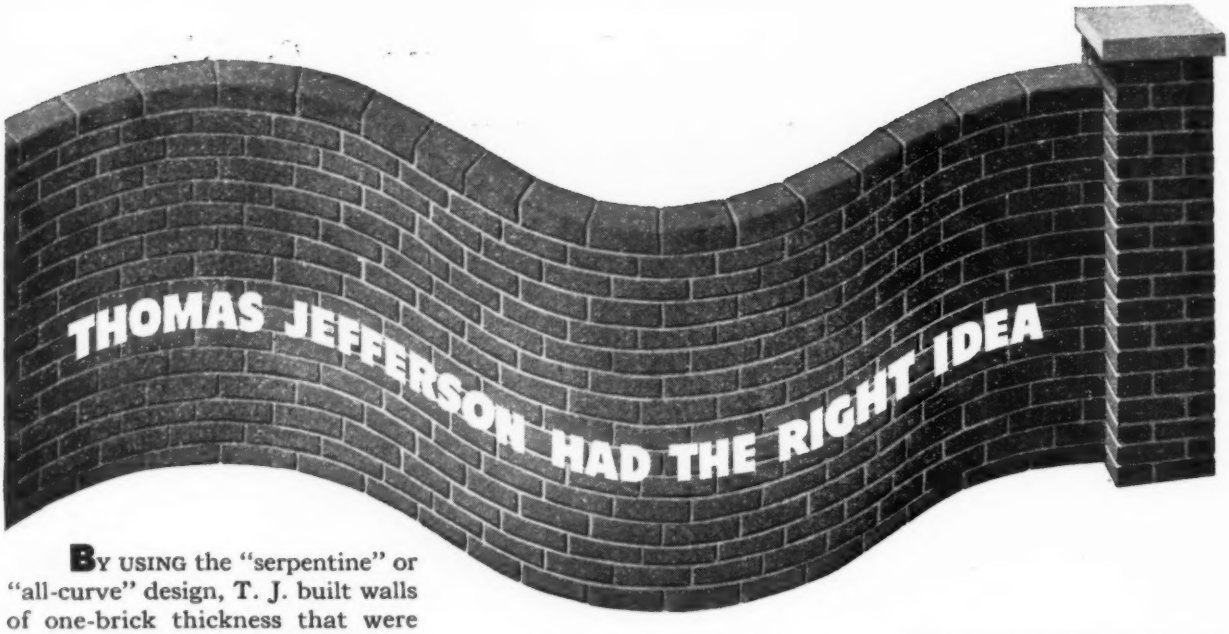
's All Back The Attack—Buy More War Bonds

ARMY E NAVY

Pittsburgh Piping AND EQUIPMENT COMPANY

10 Forty-Third Street · Pittsburgh · Penna.

Woolworth Building, New York · Occidental Building, Indianapolis · Peoples Gas Building, Chicago · Book Tower, Detroit,
Public Square Building, Cleveland · · 10 High Street, Boston · · 525 Market Street, San Francisco



BY USING the "serpentine" or "all-curve" design, T. J. built walls of one-brick thickness that were stronger than straight-line walls of double the thickness.

The same principle is used in Badger Packless Corrugated Expansion Joints. Badger ALL-CURVE corrugations, together with Badger ALL-CURVE Equalizing Rings, distribute and absorb *evenly* the normal stresses caused by pipe expansion and contraction. There is no tendency of stresses to converge or localize, as is the case with corrugations having straight sides, angles or "junctions." Badger Joints have the further advantage of

DIRECTED FLEXING

—with the Equalizing Rings doing the "directing." These rings preserve the strong ALL-CURVE contour of the corrugations—keep them from "flattening out"; hold movement within prescribed limits; form an added bulwark against excessive stresses. What these things mean in higher resistance, greater dependability, longer joint life, is clear to any engineer.

PACKLESS, too! A single piece of tubing comprises the corrugated member. No packing—hence no packing maintenance—is required. Manhole and tunneling expense is saved in underground installations.

COMPACT, as well! No space is wasted . . . Badger Joints take up no more room than a comparable flanged fitting. You can't find better expansion joints anywhere!

E. B. BADGER & SONS CO.
75 Pitts St., Boston Mass.
AGENTS IN PRINCIPAL CITIES

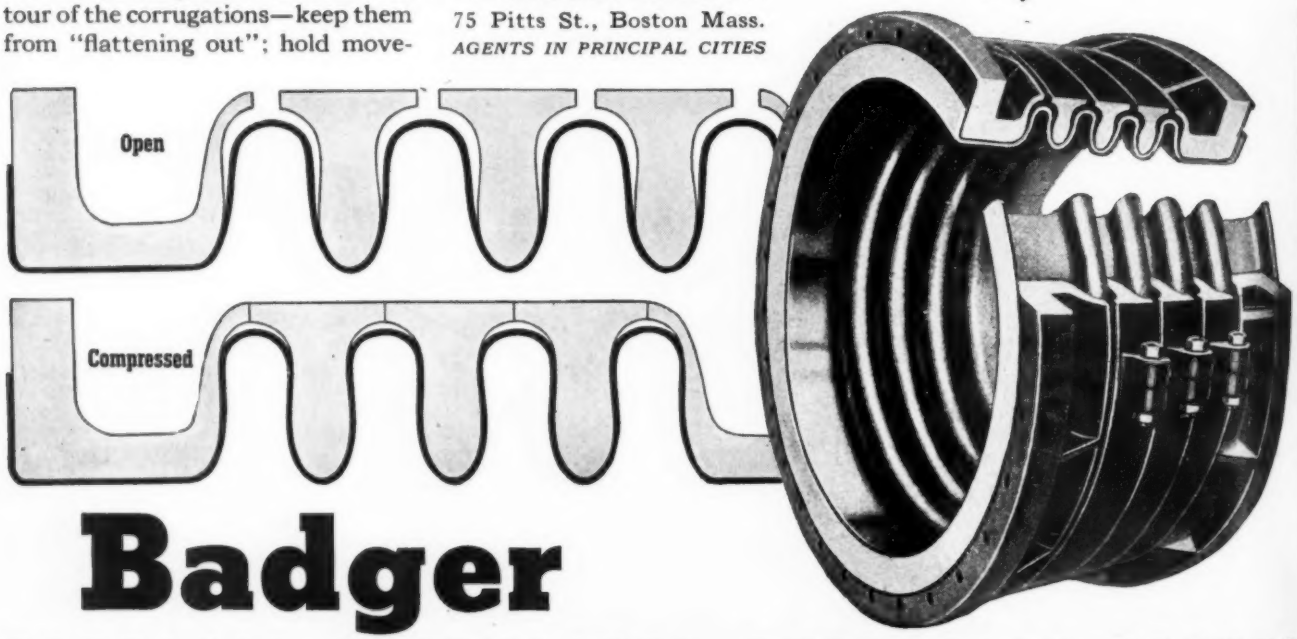
• BADGER DIRECTED FLEXING PACKLESS EXPANSION JOINTS

come in Copper for normal pressures and temperatures; in Stainless Steel for higher pressures and temperatures—and where corrosion is a problem. Single and multiple corrugations—to take care of traverses ranging from a fraction of an inch upward.

Non-equalizing type where pressures and traverses do not require the added protection of Equalizing Rings.

FREE BULLETINS: No. 100 on Self-equalizing; No. 200 on Non-equalizing.

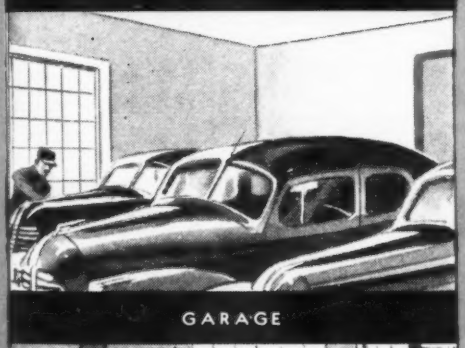
If it's Badger made it's got something

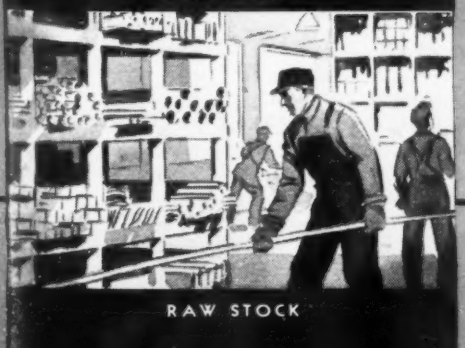


Badger

PACKLESS CORRUGATED EXPANSION JOINTS

Keep Backing the Attack — Buy MORE Bonds!



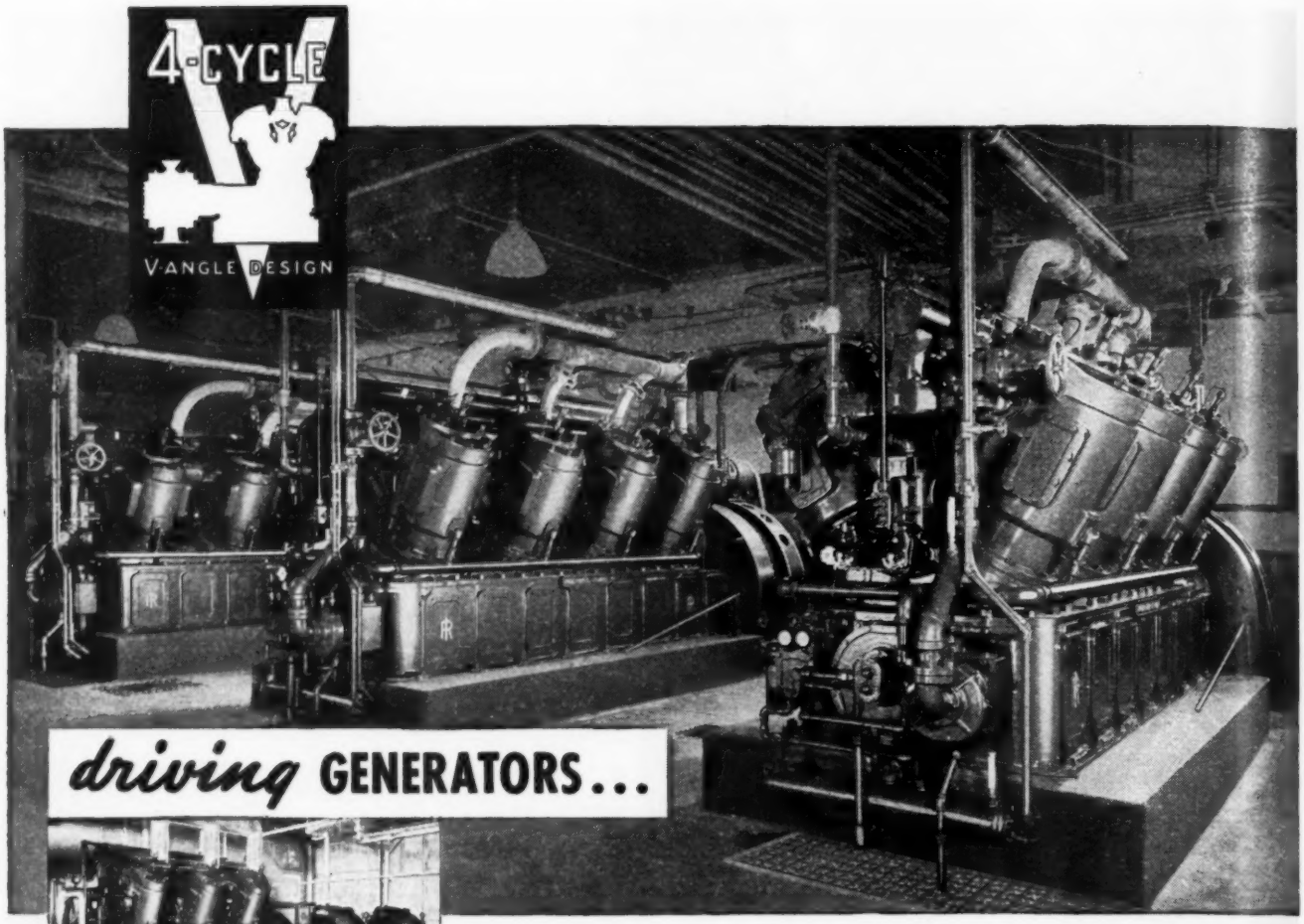


Zoned FOR FUEL SAVING

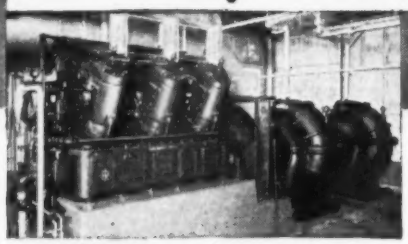
Zone control equipment, because of the fuel saving produced by this system, is of prime importance right now. Buildings, old or new, can be zoned for occupancy or for outside weather conditions. Both save fuel. In the former, heat is supplied to the various zones only to the degree needed; in the latter, overheating is avoided by supplying less heat on the warm side or sections of the building and more heat is supplied to the zone with the greatest exposure to the elements. Fuel savings resulting from Minneapolis-Honeywell Zone Control will pay its cost. The additional health, comfort and improvement in working conditions actually costs nothing. Minneapolis-Honeywell Regulator Company, 2702 Fourth Ave. S., Minneapolis 8, Minn. Branches and distributors in principal cities.

LISTEN . . . Blue Jacket Choir, with Danny O'Neil, from Great Lakes Naval Training Station, Columbia coast-to-coast network, every Sunday morning 11:05 to 11:30 Eastern War Time.

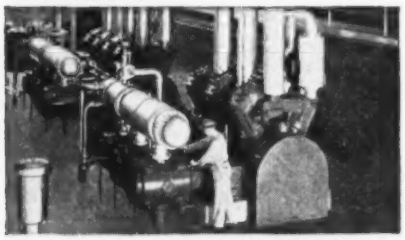
MINNEAPOLIS
Honeywell
CONTROL SYSTEMS



driving **GENERATORS...**

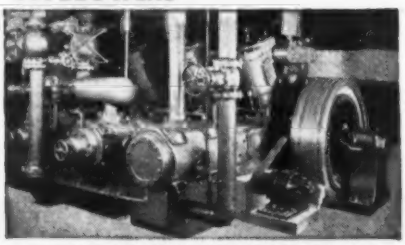


...PUMPS



...AIR & GAS COMPRESSORS

...BLOWERS



...AMMONIA COMPRESSORS

dependable

GAS-ENGINE POWER

These gas engines are designed and built for driving any kind of machinery—centrifugal and reciprocating pumps, blowers, generators, compressors, shafting, etc. If you generate power or operate such machinery, in an area supplied by natural or manufactured gas, you cannot afford to overlook the advantages of Ingersoll-Rand gas-engine power.

I-R modern, multi-cylinder, vertical engines are available in six sizes from 75 to 800 horsepower. Each is a heavy-duty unit built for continuous full-load service, week after week. Each is of the 4-cycle V-angle design...for operating economy, reliability, accessibility, and low maintenance.

For compressor service, compressor cylinders are directly attached to the engine frame, making one integral, compact unit. A wide range of engine and compressor controls and regulators is available

More than 300,000 installed horsepower of these versatile engines

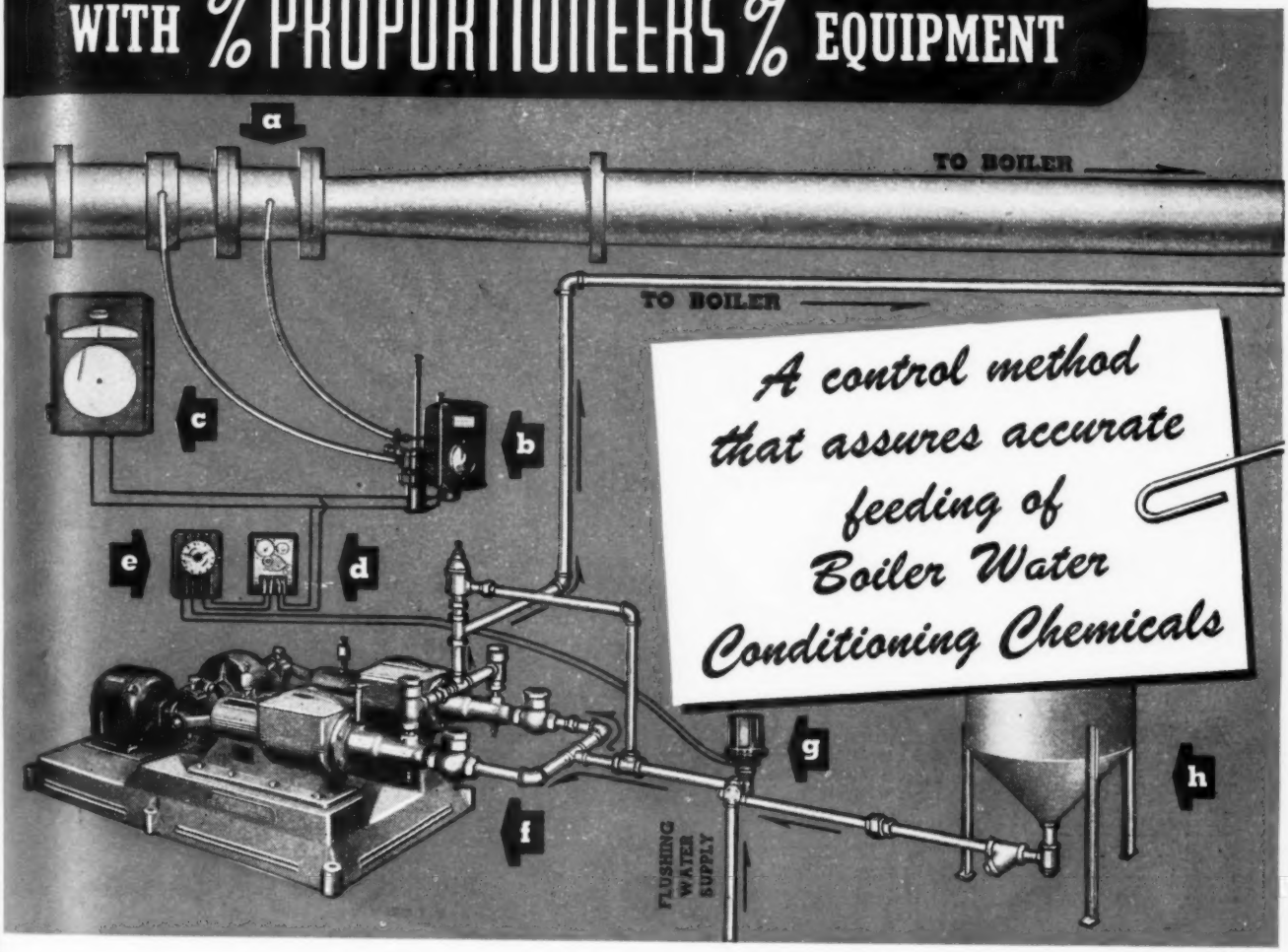
Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

6-413

COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

BOILER WATER CONDITIONING WITH %PROPORTIONEERS% EQUIPMENT



% Proportioneers, Inc. % manufactures a full line of proportioning equipment for constant rate or flow responsive feeding of chemicals for water conditioning in a wide range of capacities, engineered to fit specific applications such as phosphate feeding, oxygen removal and pH correction.

Shot Feeding OF PHOSPHATES

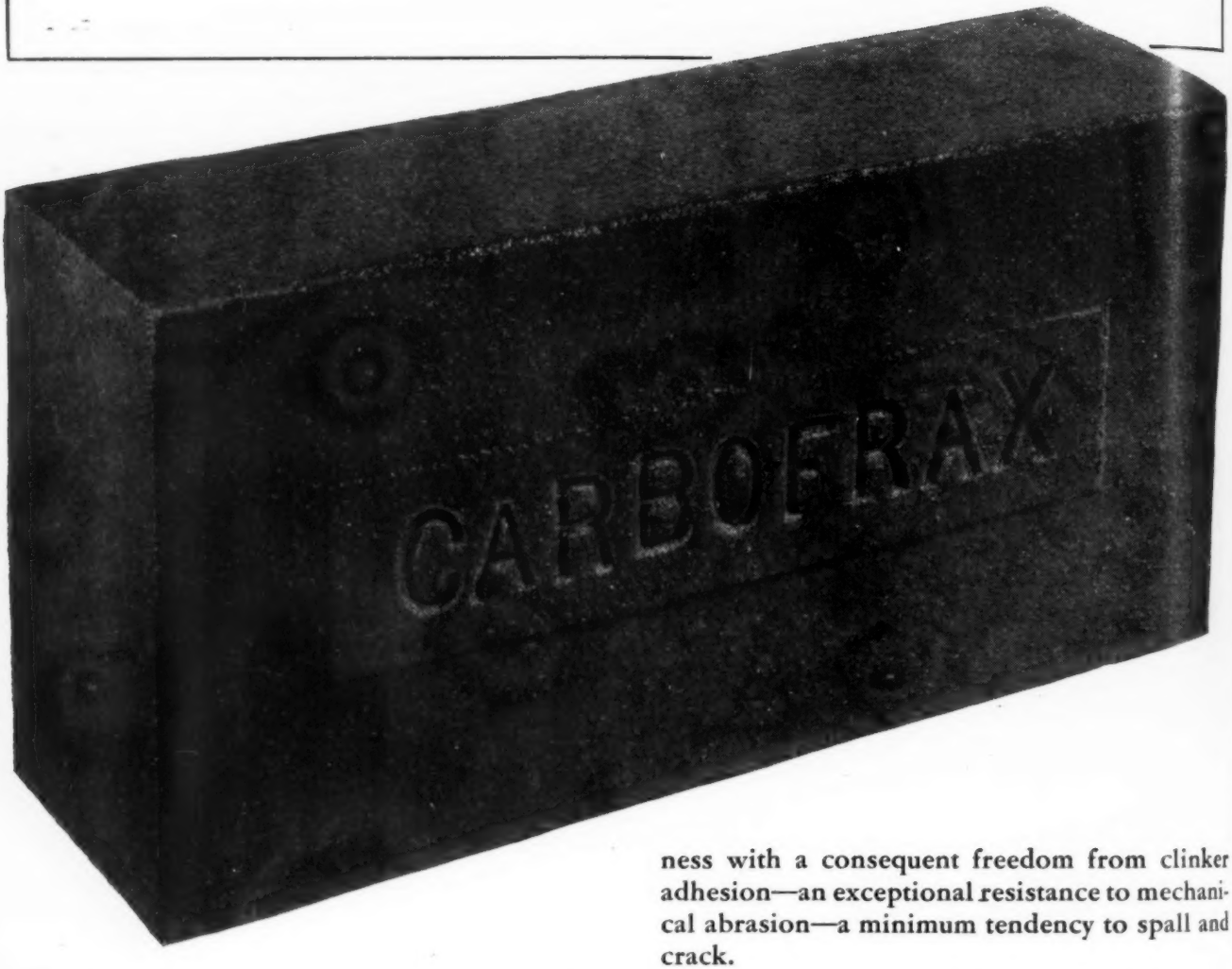
Differential set up by flow through Venturi Tube a or Orifice Plate causes transmitter b to send electrical signals whose duration lengthens with increasing flow. Instantaneous and total flows, together with permanent records, are supplied by Chronoflo Receiver c. Timer d receives signals from transmitter and, after reaching predetermined total, energizes adjustable timer e. Thereupon Adjust-O-Feeder f injects chemical and, when timer e reaches preset point, 3-way valve g shuts off chemical h and admits flushing water. After a further interval timer resets and Adjust-O-Feeder stops until next feeding cycle is initiated.

For further information send for Bulletin 1100

%PROPORTIONEERS, INC.%

WRITE TO %PROPORTIONEERS, INC.%, 16 CODDING STREET, PROVIDENCE 1, RHODE ISLAND

READY TO MEET YOUR NEEDS



IF circumstances forced you to use fireclay brick when hurriedly converting your boiler furnace to coal firing, here's a tip. You can now get quick deliveries of *Carbofrax* brick when repairs to your present setting are necessary.

Thousands of installations have proved the ability of *Carbofrax* to improve operating efficiency, lower refractory and maintenance costs, and eliminate frequent outages for setting repairs. Such results are obtained because *Carbofrax* has an extremely high refractoriness with a consequent freedom from clinker adhesion—an exceptional resistance to mechanical abrasion—a minimum tendency to spall and crack.

We'll be happy to explain how *Carbofrax* can do the same for you. Refractory Division, The Carborundum Company, Perth Amboy, N. J.

REFRACTORY
CARBORUNDUM
PRODUCTS

District Sales Branches: Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh. Distributors: McConnell Sales and Engineering Corporation, Birmingham, Ala.; Christy Firebrick Company, St. Louis, Mo.; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Company, Los Angeles, San Francisco, Calif.; Denver Fire Clay Company, El Paso, Texas; Smith-Sharpe Company, Minneapolis, Minn.

Super Refractories by CARBORUNDUM
TRADE-MARK

(Carborundum and Carbofrax are registered trade-marks of and indicate manufacture by The Carborundum Company)

KEEP EQUIPMENT HUMMING WITH THE HELP OF TIMKEN BEARINGS

THESE Ingersoll-Rand Air Compressors furnish air for forging hammers and for various purposes in the machine shops of a large industrial plant.

The use of Timken Tapered Roller Bearings on the crank shafts is an important factor of steady, dependable performance; economical operation; low maintenance; and extended equipment life.

When you buy a compressor equipped with Timken Bearings you are sure of getting every benefit that anti-friction bearings can give. For Timken Bearings not only eliminate friction; they also carry radial, thrust and combined loads and hold moving parts in correct and constant alignment.

You need these advantages in your compressors for top-notch results. Make sure *you* get them. Specify "Timken Bearing Equipped." The Timken Roller Bearing Company, Canton 6, Ohio.

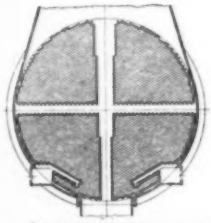
TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

28 Years of C. H. Wheeler DUAL BANK CONDENSERS

KEEP PACE WITH IMPROVEMENTS IN TURBINE DESIGN

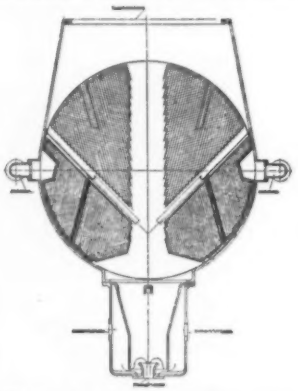
As the Steam Turbine was developed for higher vacuum, C. H. Wheeler Condensers followed the same trend.

1916 **THE FIRST C. H. WHEELER CONDENSER** with which the steam ejector type air pumps were used is shown by this actual installation tube sheet.



Result: Condensate temperatures within 5° of temperatures corresponding to vacuum.

1923 **IMPROVEMENT:** Wider steam lane and hotter condensate—shown in literature published at that time.



Result: This produced condensate temperature corresponding to temperature of vacuum and the oxygen content was less than 0.03 cc per litre.

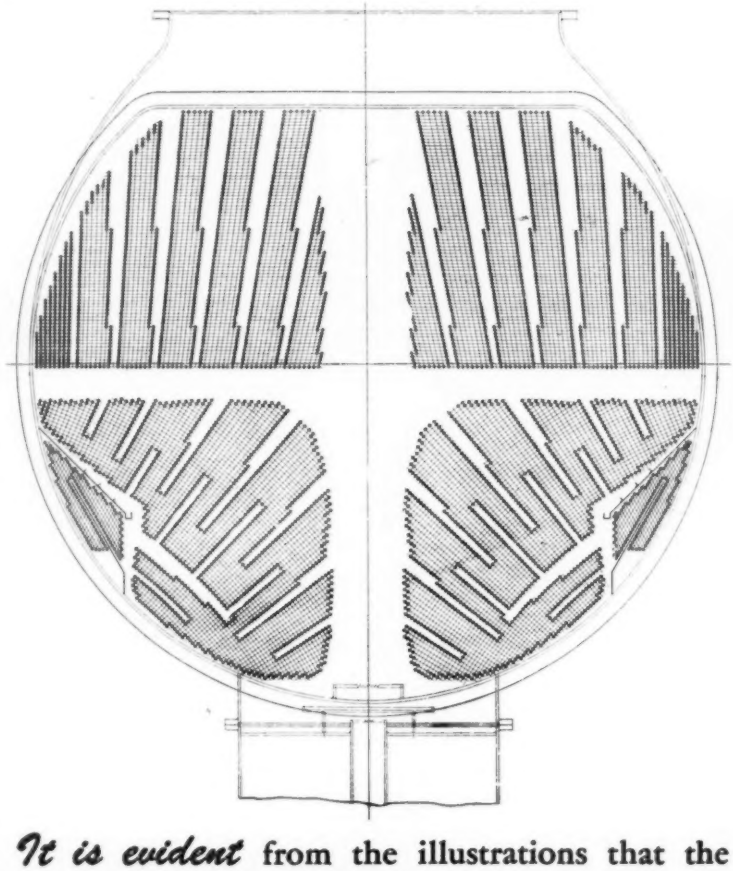
1929 **FURTHER IMPROVEMENT:** More open area for entering steam—illustrated in literature published at that time.

Result: Less pressure drop.

1944

ARMY E NAVY

NOW—Additional steam lanes give deeper penetration for the entering steam!



It is evident from the illustrations that the C. H. Wheeler Manufacturing Company has pioneered the development of this highly efficient Dual Bank Condenser.

PRODUCTS: Surface Condensers • Steam Jet Ejectors • Cooling Towers • Deck Machinery

C. H. WHEELER MANUFACTURING CO.

19th ST. and LEHIGH AVE., PHILADELPHIA, PA. *of Philadelphia*

DON'T WASTE HEAT

SAVE IT with MAXIM HEAT RECOVERY SILENCERS

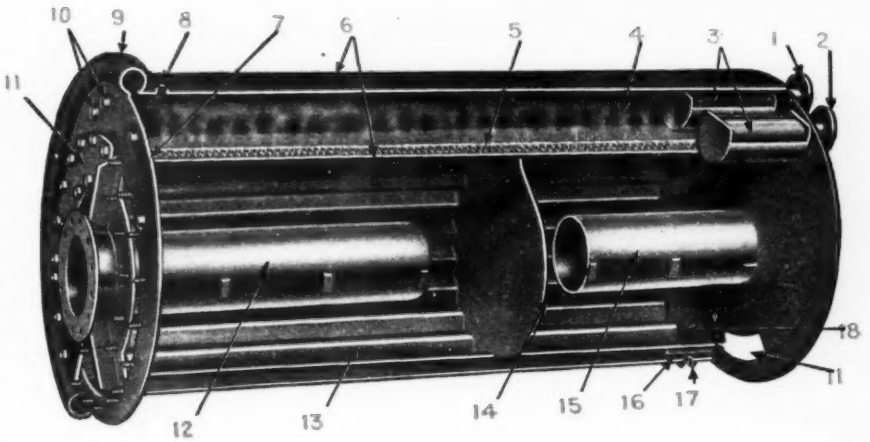
Maxim Heat Recovery Silencers convert waste exhaust heat into steam or hot water for industrial processing operations or for heating.

These Heat Recovery Silencers provide effective silencing of exhaust noise and are available with or without the spark arrestor feature.

A highly efficient heat transfer is achieved through high mass gas velocities and the use of extended heating surfaces. Because of this type of construction (no tubes) it is possible to run dry without damage to the unit. Automatic control of water level through steam pressure regulated valves controls steaming rate, and because the unit can be run with or without water, complete automatic control of output is possible.

Maxim engineers will be glad to work with you to determine the most efficient set-up for your particular case. Maxim Bulletins WH-100, WH-102 and WH-103, describing these Heat Recovery Silencers, will be sent to you on request.

For silencing, without the heat recovery feature, investigate the broad range of usefulness covered by Maxim Silencers . . . for internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge, high velocity steam, air or gas discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request.



1—Steam Outlet
2—Safety Valve Connection
3—Dry Pipes
4—Steam Space
5—Water Line
6—Shells—Cylindrical to withstand steam pressure and pulsating gas flow
7—Inlet Head
8—Pressure Gauge Connection
9—Expansion Joint—permits dry operation
10—Water Gauge Connections
11—Cleanouts—provide easy access for cleaning heating surface
12—Inlet Bleeder Tube
13—Extended Heating Surface—forming conduits for leading exhaust gases from one attenuating chamber to the other
14—Insulated Intermediate Head
15—Outlet Bleeder Tube
16—Feed Water Deflector Plate
17—Feed Water Connection
18—Exhaust Gas Outlet from side conduits formed by extended heating surfaces

THE MAXIM SILENCER CO.
92 Homestead Ave., Hartford, Conn.

ARMY E NAVY

MAXIM

"Now, I don't mean purchase price...LUBRIPLATE probably costs a lot more per pound than the grease you are now using... what I'm getting at is the over all costs.

"LUBRIPLATE lasts longer...yes, it does. You see the film is tougher...it stands up longer. A lot of fellows who use LUBRIPLATE tell me they have been able to stretch their lubrication schedules. This in itself is a saving.

"But the big thing is LUBRIPLATE arrests progressive wear and prevents rust and corrosion. Sure you save on parts replacement and machine shutdown...and as to lubrication...LUBRIPLATE is the slipperiest stuff you can put on a bearing. Of course it saves on power. All and all LUBRIPLATE is the most economical lubricant you can use."

• • • •

Don't take our salesman's word for the economy and efficiency of LUBRIPLATE. Let us send the "LUBRIPLATE FILM" written especially for your industry. Read the case histories and unsolicited testimonials of other users. Write for a copy today.

Rx FOR YOUR MACHINERY

No. 3—Ideal for general oil type lubrication. Ring oiled bearings, wick feeds, sight feeds and bottle oilers.

No. 8—Because of its high film strength and long life reflects outstanding performance in most types of enclosed gears (speed reducers).

No. 107—One of the most popular grease type products for general application by pressure gun or cups.

No. 70—For a wide range of grease applications, especially at temperatures above 200 degrees F.

No. 130-AA—Known nationwide as the superior lubricant for open gears, heavy duty bearings, wire rope, etc.

BALL BEARING—This is the LUBRIPLATE lubricant that has achieved wide acclaim for use in the general run of ball and roller bearings operating at speeds to 5000 RPM and temperatures up to 300 degrees F.

LUBRIPLATE DIVISION

FISKE BROTHERS REFINING COMPANY

NEWARK, N. J. **SINCE 1870** TOLEDO, O.

WRITE FOR THE NAME OF THE DEALER NEAR YOU

What's Behind the Trade Mark?

QUALITY

TRADE MARK

YOUNGSTOWN

SERVICE

Advance Against Depression

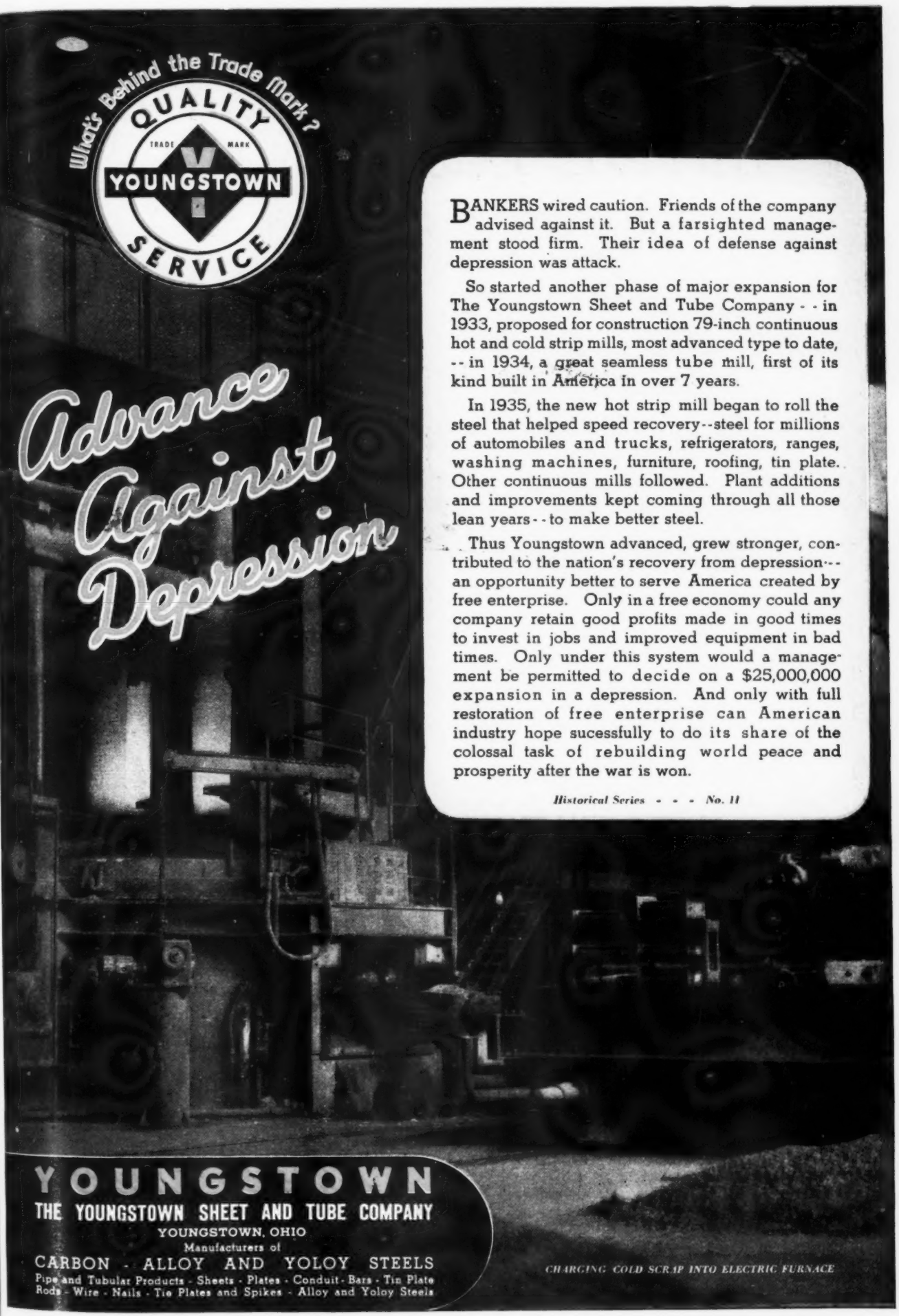
BANKERS wired caution. Friends of the company advised against it. But a farsighted management stood firm. Their idea of defense against depression was attack.

So started another phase of major expansion for The Youngstown Sheet and Tube Company - - in 1933, proposed for construction 79-inch continuous hot and cold strip mills, most advanced type to date, -- in 1934, a great seamless tube mill, first of its kind built in America in over 7 years.

In 1935, the new hot strip mill began to roll the steel that helped speed recovery--steel for millions of automobiles and trucks, refrigerators, ranges, washing machines, furniture, roofing, tin plate. Other continuous mills followed. Plant additions and improvements kept coming through all those lean years--to make better steel.

Thus Youngstown advanced, grew stronger, contributed to the nation's recovery from depression--- an opportunity better to serve America created by free enterprise. Only in a free economy could any company retain good profits made in good times to invest in jobs and improved equipment in bad times. Only under this system would a management be permitted to decide on a $25,000,000 expansion in a depression. And only with full restoration of free enterprise can American industry hope sucessfully to do its share of the colossal task of rebuilding world peace and prosperity after the war is won.

Historical Series - - - No. 11



CHARGING COLD SCRAP INTO ELECTRIC FURNACE

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Manufacturers of

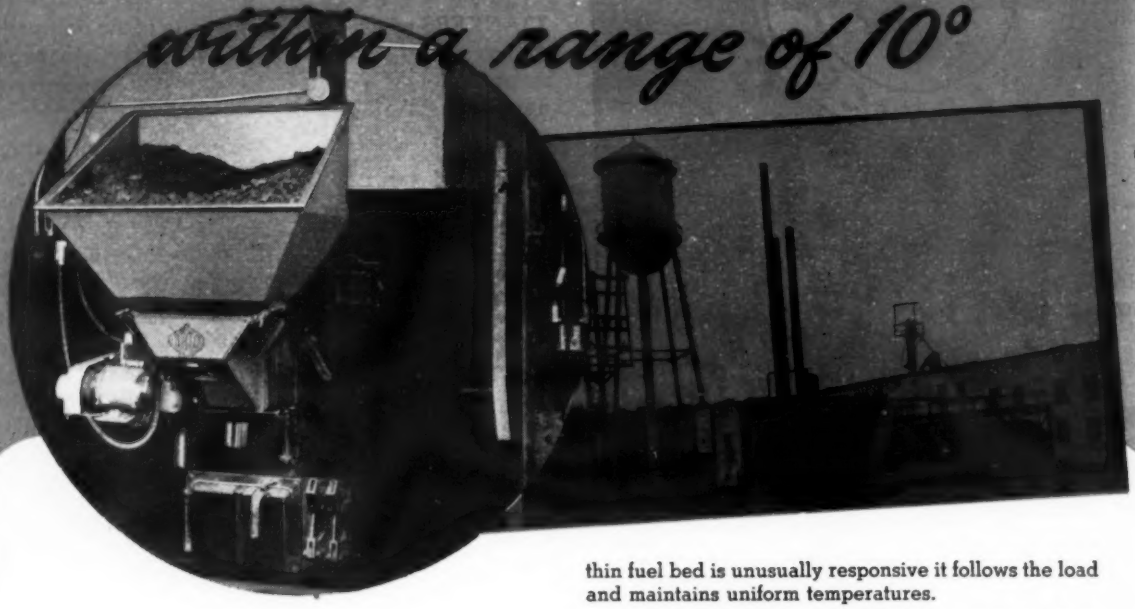
CARBON - ALLOY AND YOLOY STEELS

Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Tin Plate

Rods - Wire - Nails - Tie Plates and Spikes - Alloy and Yoloy Steels

MAINTAINING CIRCULATING HOT OIL TEMPERATURES

within a range of 10°



● Artic Roofings, Inc., of Edge Moor, Delaware, manufactures Asphalt Roll Roofing and Asphalt Shingles. In the process the material is passed through baths of hot asphalt at high speeds.

The special problem at Artic, according to W. Freegard, Vice-President, is to maintain the temperature of the saturating bath and coating asphalts to a very narrow optimum working temperature. Economical, uninterrupted production depends on this temperature. This puts a pretty exacting job up to the heating and firing equipment. Circulating hot oil is the heating medium used to maintain this temperature on the roofing machine and in storage tanks. This circulating hot oil is heated in a special heat exchanger fired by a Bros Super-Spred Stoker, which replaced the original oil burner. The circulating hot oil is being maintained with the automatic temperature controls within a ten degree range.

Due to the serious fuel situation in their territory, the Artic Company had to free itself from dependence on a single critical fuel such as oil—and at the same time could not confine its requirements to a single grade of coal. It had to put itself in a position to burn any available coal.

Bros Super-Spred Stoker solved the fuel situation and met the firing requirements. Bros burns any available fuel with maximum efficiency, and because its thin fuel bed is unusually responsive it follows the load and maintains uniform temperatures.

If you're planning a new installation, conversion or modernization of boilers or fuel feeding equipment Bros can be of service with its single source of supply —its undivided responsibility for the complete job. Detailed literature on Bros Boilers and Super-Spred Stokers available. Write...

WM. BROS BOILER & MFG. CO.

Minneapolis, Minnesota

BROS PERFORMANCE CHECK LIST

How does this compare with your present operation?

	Artic Roofings, Inc.	Your Plant
Process Temperatures Maintained Uniformly	Circulating oil for heating held within 10 degrees, permitting economical, uninterrupted flow of roofing felt through asphalt bath.	
No Fuel Shortages Here	Conversion from oil to Super-Spred Stoker firing provides efficient operation with cheapest available local coal.	
Maximum Flexibility in Operation	Thin responsive fuel bed follows fluctuating load closely.	

BROS *Super-Spred* STOKER

VISIBLE PRESSURE SEAL

...in this high-pressure "L" Head stage heater

The pressure-sealing member and head cover gasket of the G-R Type "L" Stage or Extraction Heater are located OUTSIDE of the cover.

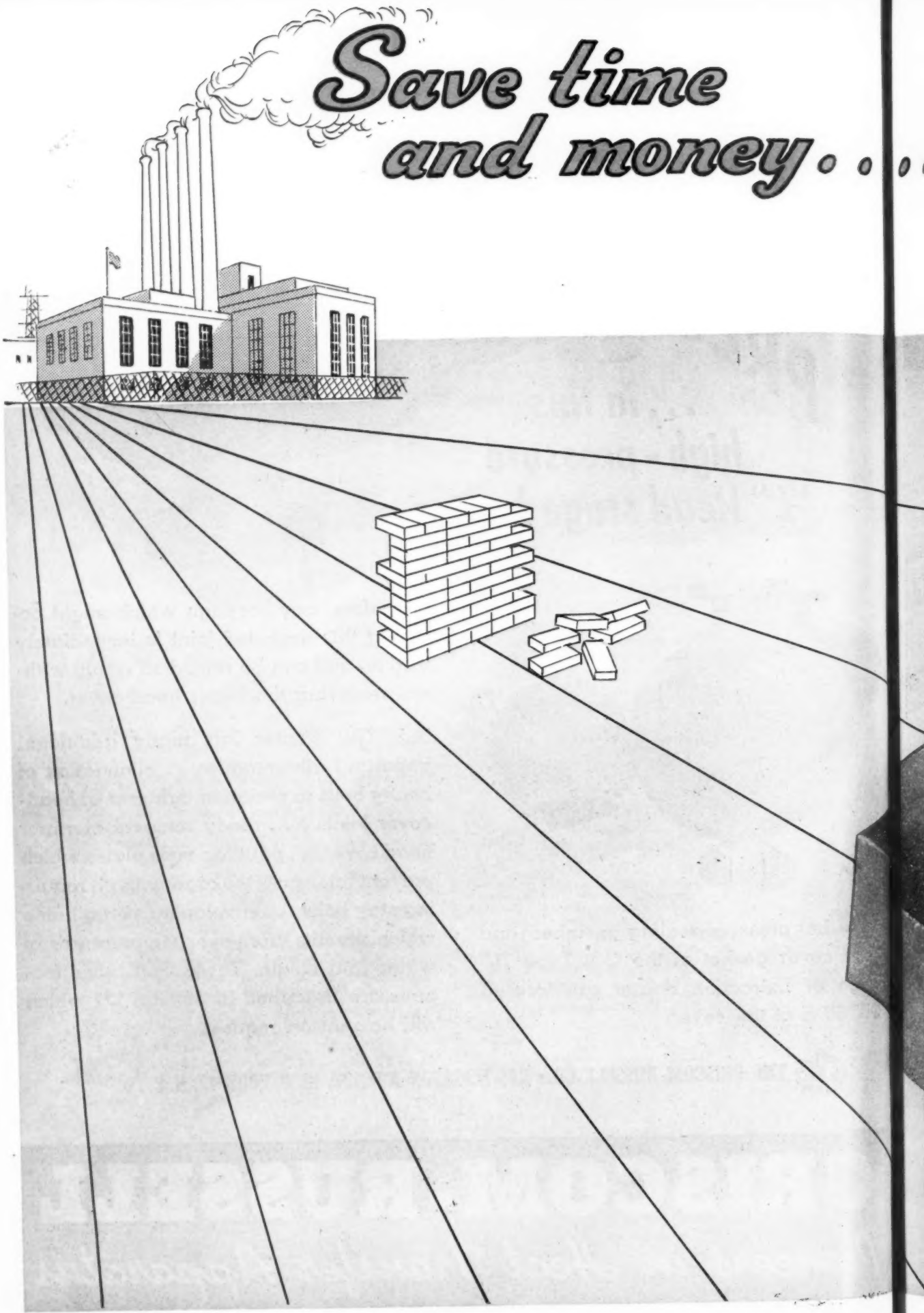
Therefore, any seepage which might occur at this gasketed joint is immediately visible, and can be remedied easily without removing the water head cover.

This G-R Heater has many additional important advantages . . . elimination of heavy bolts to maintain tightness of head-cover joints . . . ready removal of water head cover . . . partition pass plates which prevent inter-pass leakage without requiring stay bolts . . . enveloping steam baffle which permits cross-over temperatures of water and steam. These and other features are described in Bulletin 277 which will be sent on request.

THE GRISCOM-RUSSELL CO. • 285 MADISON AVENUE, NEW YORK 17, N.Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus


Save time
and money . . .

. . . with CRYSTOLON brick

NORTON CRYSTOLON Brick are bringing real savings in time and money to power plant operators. Densely constructed of silicon carbide plus a highly refractory bond and fired at high temperatures these rugged brick will not spall under peak operating conditions. Their dense surface resists slag adhesion and penetration making clinker removal a short, easy operation. CRYSTOLON Brick are unaffected by the corrosive action of coal ash slag.

R-872

NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

Norton Longer Lasting Refractories

THE SPEED REDUCER *that Mounts on the Shaft!*

Only American Reduction Drives Give You These Advantages:

Easy to Obtain

Available in six standard stock sizes to fit jobs from ¼ to 25 H.P.—American Reduction Drives are bought "off-the-shelf" from a catalog just like any tool.

Easy to Install

The Reduction Unit mounts directly on the shaft of the driven machine—as quickly and simply as a pulley. Since no expensive drive supports or foundations are needed, it is exceptionally economical.

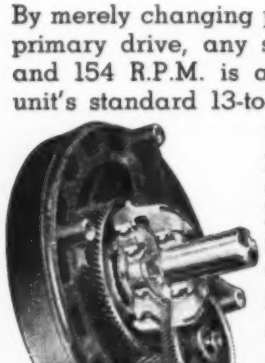
Space Saving

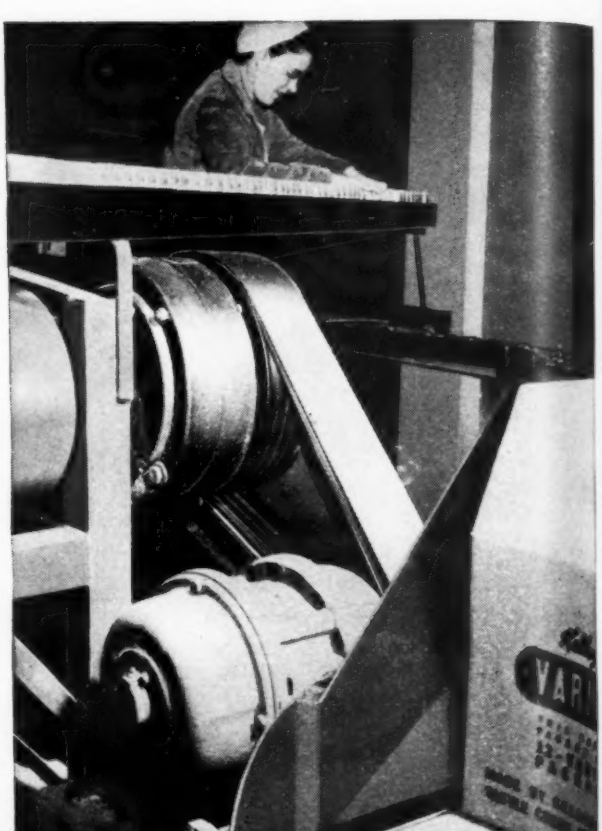
Its compact design—its "mounts-on-the-shaft" feature—make the American Reduction Drive unique in the field of modern speed reducers.

Top Efficiency UNDER 154 R.P.M.

Frictional losses are never over 1½%—considerably lower than ordinary gear assemblies.

By merely changing pulley or sheave sizes in the primary drive, any speed you need between 11 and 154 R.P.M. is accurately delivered by the unit's standard 13-to-1 ratio. *Any* motor can be used. Maintenance is no problem because the *belt* absorbs the impact of shock loads and acts as a "cushion" to save motor and gear wear. Get all these exclusive benefits by equipping your slow-speed machines with American Reduction Drives.





Kellogg benefits through American Reduction Drive's exclusive advantages. The Kellogg Company—makers of cereal foods—operate this conveyor at a speed of 20 R.P.M.—driven by a 1200 R.P.M. motor through an American Reduction Drive. The standard 13-to-1 ratio of the Reduction Unit makes it easy to get the desired driven speed by simply selecting the necessary sheave sizes in the primary drive. Compactness and ease of mounting on the shaft of the driven machine make the American Reduction Drive unique.

WEDGBELT SHEAVES

American Wedgbelt Sheaves are made to the highest precision standards. They are made of sound, strong metal, accurately machined, finely finished and carefully balanced.

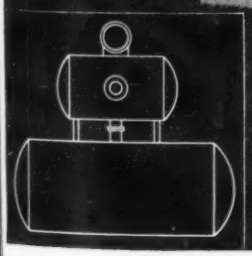
The American Pulley Company

4226 WISSAHICKON AVE., PHILADELPHIA 29, PA.

Helping CAPE FEAR "Speed the Peace"

CAPE FEAR STATION of the Carolina Power & Light Company last year added 60,000 Kw. generating capacity in two units to the original 35,000 Kw. completed in 1923. This combined 95,000 Kw. is, as the opening ceremonies phrased it, "dedicated to speeding the peace"—doing so by furnishing electricity for thousands of war production jobs.

The Cochrane Deaerator shown in this photograph, a part of this magnificent equipment, has the capacity to produce 600,000 lbs. per hour of oxygen-free water, heated to the full temperature of the steam extracted from the new turbines. Surge capacity for the feed system is supplied by a large storage tank on which the deaerator is mounted.



COCHRANE CORPORATION 3106 N. 17th ST. • PHILADELPHIA 32, PA.

COCHRANE

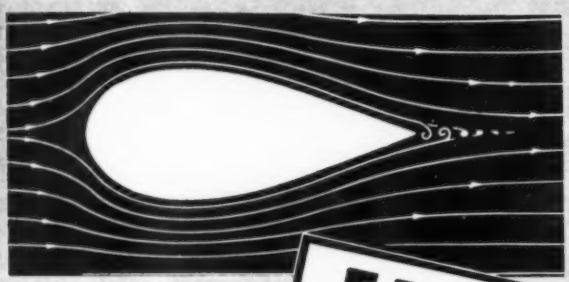
SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

Scientific Streamlining

PREVENTS THIS TYPE OF FLOW . . . .

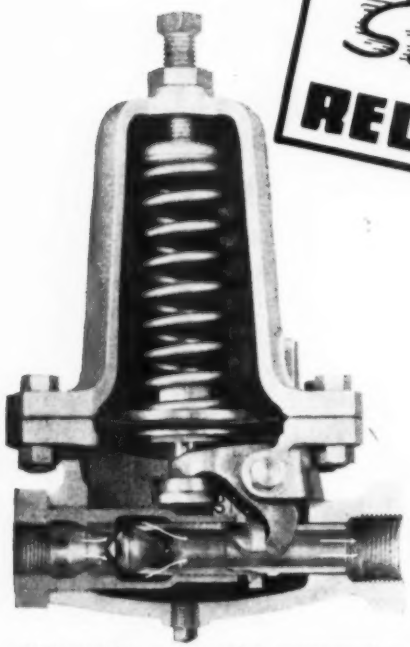
• This type of flow is experienced where there is no Streamlining, with the result that you can't be sure of maximum capacity under peak pressure. When you have conditions that cause downstream turbulence (see this in chart at right) the greatest amount of turbulence (causing greatest pressure drop) will occur when you want maximum flow and therefore want least pressure drop.

and produces this highly efficient flow

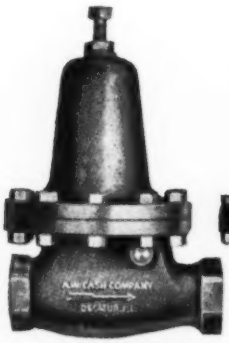


• The "1000" Valve has straight line flow of steam, water, air, oil, etc. through the jet to the outlet pipe. Because there is no detour around a dividing wall, no valve stems, springs, or other parts, the fluid flows smoothly even with supply line and demand changes. There are no back eddies to cause turbulence. It is the modern answer if you are trying to insure better pressure control and get greater capacity.

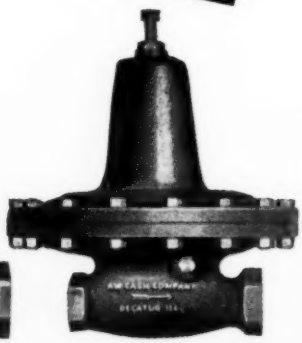
CASH STANDARD Streamlined PRESSURE REDUCING VALVES TYPE 1000



○ The positive moving valve arrangement in STREAMLINED housing, with its continuous-duty performance, insures against trouble from gumming up, thereby minimizing maintenance.



Type 1000—HP
Normal size diaphragm. Made for high delivery pressure.



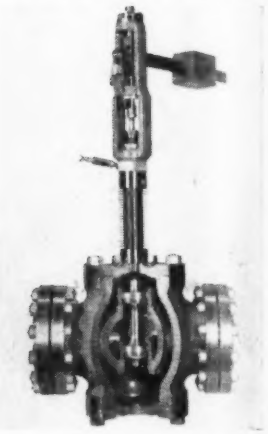
Type 1000—LP
Has large diaphragm. Made for low delivery pressure.

• Write for Bulletin 1000 to get details on elimination of erratic pressure, savings in operating and maintenance costs and complete performance facts of the Streamlined Type 1000 Valve.

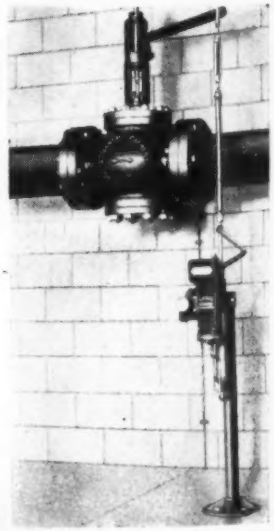
CASH STANDARD CONTROLS . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

OTHER VALVES from the CASH STANDARD LINE



Cash Standard Balanced Valves, Series 42, have no lost motion. Have roller guides that kill side strains; stop packing trouble. Practically no maintenance. Sizes ½" to 12"; pressures up to 600 lbs. temperatures to 800° F. Bodies: iron, bronze, steel; all standard trims. With Air Cooled Packing Box (42-AC-R) shown above; or water cooled; or no cooling box. Made also with center guide. Bulletin 965.



The Cash Standard Type 100 Controller above is operating an 8" Type 42-R Balanced Valve, automatically reducing 250 lbs. down to 125 lbs. pressure, handling 200,000 lbs. steam per hour.

Type 100 Controllers have lots of operating power, enough for any size valve; are fully compensated; have adjustable range; are very sensitive. Bulletin 963 covering the Controller and Bulletin 965 covering the Valve give complete and interesting details. Write for them.

Featherweight Fans

keep operating costs down in

Pritchard

Mechanical Draft COOLING TOWERS

COOLING FACTS about PRITCHARD TOWERS

1. Low Pumping Head—uniform water distribution.
2. Maximum water breakup with minimum airflow resistance.
3. Rugged construction — liberal safety factors.
4. Sized and rated for specific job.
5. Greater evaporative cooling effect.
6. Only finest selected Redwood used in all Pritchard towers.

The design of the mechanical equipment used in cooling towers determines the operating cost. The unique Pritchard *Featherweight Fan,* standard equipment in all Pritchard Mechanical Draft Cooling Towers was designed to increase efficiency and thereby reduce operating costs. Made of wrought monel metal, the fan will not corrode or pit. Its airfoil section blades are of the "stressed skin" design and adjustable in pitch. They deliver a uniform flow of air across the entire fan opening. Two to six blades, seven to seventeen feet in diameter, strongly reinforced inside and individually bolted to a monel hub, can deliver up to 400,000 cubic feet per minute.

Pritchard fans reduce operating costs in four ways: (1) Light in weight, they require less power, (2) Corrosion resisting monel metal reduces maintenance costs, (3) Non-pitting, they maintain their high efficiency, (4) Unique design gives maximum air flow.

J. F. PRITCHARD & COMPANY, *Cooling Tower Division,* Fidelity Building, Kansas City, Missouri.

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Manufacturers of Mechanical and Atmospheric Cooling Towers

Looking ahead with Asbestos

"Leave it to that starter cartridge to do a job. A snap of the switch and the engine's *gotta* spin. Helps get a plane into the air—*sure*—when a split-second counts! Smart idea, that cartridge—and I understand one of the most important things in it is a small disk made of asbestos packing."

Right you are, Sergeant. That asbestos disk in the back of the cartridge directs the entire explosive action forward. What's more, it's K&M Asbestos Sheet Packing in 75% of all aircraft starter cartridges.

K&M is a name that a lot of airmen will remember when they go back to civilian jobs. They will know it stands for downright dependability. They will rely on it for better packing performance with air, steam, oil, water, acid or gas in the "V" years to come.

Emergency production for war has taught manufacturers many a lesson—and as with K&M, has pointed out the way to produce more, faster, with less. We have confidence that Industry will use this important lesson—aided by constant research—to help in building a better peacetime world.

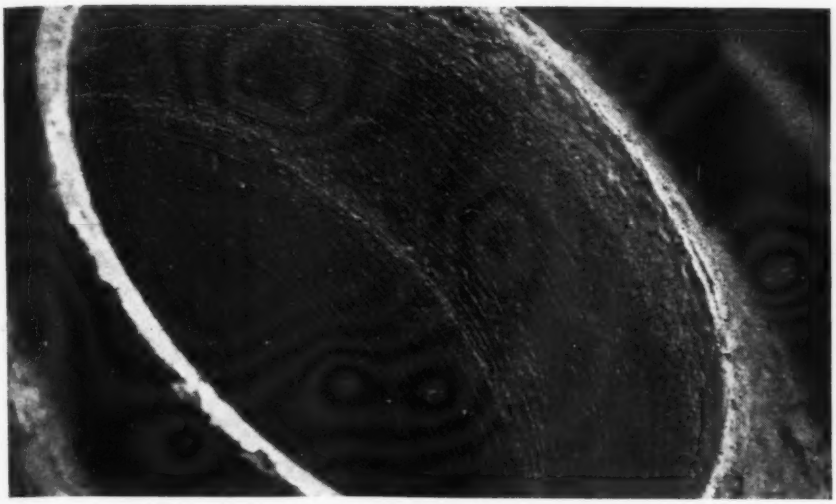
* * *

Nature made asbestos:
Keasbey & Mattison, America's asbestos pioneer, has made it serve mankind . . . since 1873

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

★ Our Ambler plants proudly fly the Army-Navy "E" flag—an honor awarded K&M employees "for outstanding production of war materials."

How Much Longer Will Your Boilers Stand Up?



Old Tube (enlarged) APEXIORIZED to prevent further wear

Send for bulletin 1290 which gives the facts on a paint that gives new life to metal.

Users like these have Apexiorized their equipment. Try it on yours.

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Chicago-Bridge & Iron Company
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In these days of supercolossal war schedules, do you ever worry about the condition of your plant boilers? Do you wonder what you can do to prolong their life until the time when scarce metal becomes plentiful once more?

Many maintenance engineers have found the answers to these questions in APEXIOR . . . a special protective coating purposely made for boiler and turbine metal.

They have used APEXIOR on new equipment as well as on old equipment . . . on new equipment to insure against premature old age, on old equipment to prolong its useful service. They have, in some cases, been able to salvage discarded boilers that seemed to have outlived their usefulness by cleaning them and then coating them with APEXIOR.

APEXIOR PREVENTS CORROSION FOR 2-3 YEARS

APEXIOR is brush-applied, by hand or power coater. It seeps into the metal pores and joints and forms an impenetrable barrier against water. There is less adherent scale, so scale removal is required less often . . . and when it is necessary, the job can be done easily with a wire brush.

Painting boiler metal with APEXIOR is recommended by boiler insurance companies. And many turbine manufacturers coat shafts, rotor bodies, and, frequently, interiors of casings with APEXIOR before shipping to customers.

APEXIOR is the safe, sure answer to . . . how can boiler life be extended? It will save your boiler metal from the ravages of rust that can not be measured in dollars today. Get the facts today.

APEXIOR REG. U.S. PAT. OFF.

A Peacetime Plus ★ ★ ★ A Wartime Must

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

The **DAMPNEY COMPANY of America**
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Mass.

Please send free Bulletin 1290 (Industrial) ☐ 1305 (Marine) ☐

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Main Office: **HYDE PARK • BOSTON • MASS.** • Branch Offices: **ATLANTA • CHICAGO • NEW YORK • DETROIT • PHILADELPHIA**

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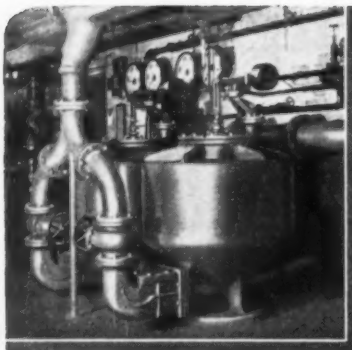

IN all these distinguished buildings you will find Yeomans Shone-Type Pneumatic Sewage Ejectors attending quietly, efficiently to their job—some of them for as long as a quarter-century without requiring attention.

YEOMANS BROTHERS COMPANY

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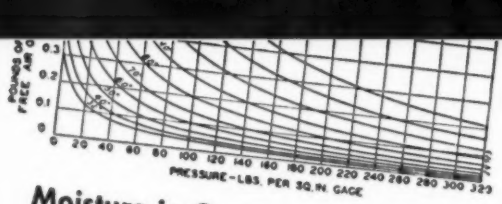
Good Investments FOR THE FUTURE

United States War Bonds and Super-Silvertop Steam Traps have a common, outstanding advantage. They are both good investments for the future. War Bonds can and should be purchased now! Your country needs every dollar you can possibly spend on Bonds. Too, excess dollars — invested in War Bonds — will help keep prices down and prevent uncontrolled inflation. War Bonds become a real financial "back log" for the future... The purchase of

Super-Silvertop Steam Traps, too, is an investment for the future. These traps — made of the finest materials and workmanship — begin paying interest through savings from the time of purchase... saving on installation time, less fittings, less repairs and more years of service... Buy War Bonds today, buy Super-Silvertops when you need them.

THE V. D. ANDERSON COMPANY
1934 West 96th St. • Cleveland 2, Ohio

Super-Silvertop
STEAM TRAPS



Moisture in Compressed Air . . .

There is no such thing as *dry* Atmospheric Air. According to records of the U. S. Weather Bureau — collected from widely separated points in the United States — the yearly average humidity shows a high of 86.5% and a low of 40.5%.

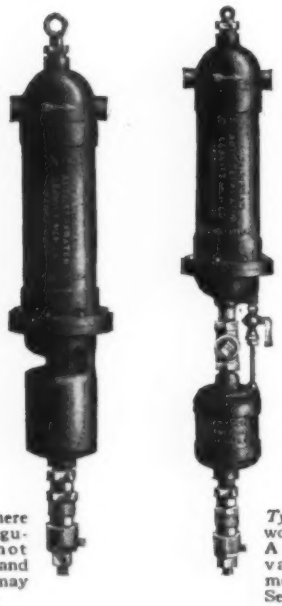
Assuming that free air with an average humidity of 60% is compressed to 90 lbs. gauge in a single stage compressor, its temperature at delivery will usually be well above 300° F. Relative humidity at this high temperature will be quite low, *although the air still carries all the moisture with which it started.* If it could be used "hot," some of the troubles due to precipitation of moisture would disappear. But usually the air must be carried by pipe line or hose to work located at some distance from the compressor, and during this transportation the temperature of the air falls, and condensation forms.

Moisture condenses into actual water, forming a mist until the saturation or *dew point* is reached, when the water is freed and settles in the pipe line, to be carried along by the air stream. In this way the moisture gets into the mechanisms of pneumatic machines, and appears as "rain" in the air streams at the nozzles.

Condensed moisture will not precipitate into a trap or any airbound receptacle while the air is in motion. It will collect in such trap while the air is quiet, but will again be picked up and carried along when the air reaches sufficient velocity. Thus the hand-operated or automatic intermittent trap does not succeed in freeing the air of all of its entrained moisture.

Swendeman Separators

free air of entrained moisture, oil and dirt.



Type A – where pressure regulation is not necessary, and where air may be shut off.

Type C – same work as Type A, but has valve equipment between Separator body and Eliminator.

The Swendeman Separator is not a trap: it is never closed, and retains no oil or water. Air, laden with moisture, oil, dust particles and scale, is caused to pass successively through two vertical expansion chambers within which the heavier globules of oil and water — and other foreign matter — separate from the air and fall to the bottom, passing through a Separator Drain into a Pressure Equalizer chamber, from which they are discharged to atmosphere. This separation and discharge are continuous, and result in delivery of clean dry air at the point of work.

The number of separators required, their sizes, types and locations, depend upon the size of the system, the work performed, type of compressors used, and whether after-cooling or re-heating apparatus is employed in the lines.

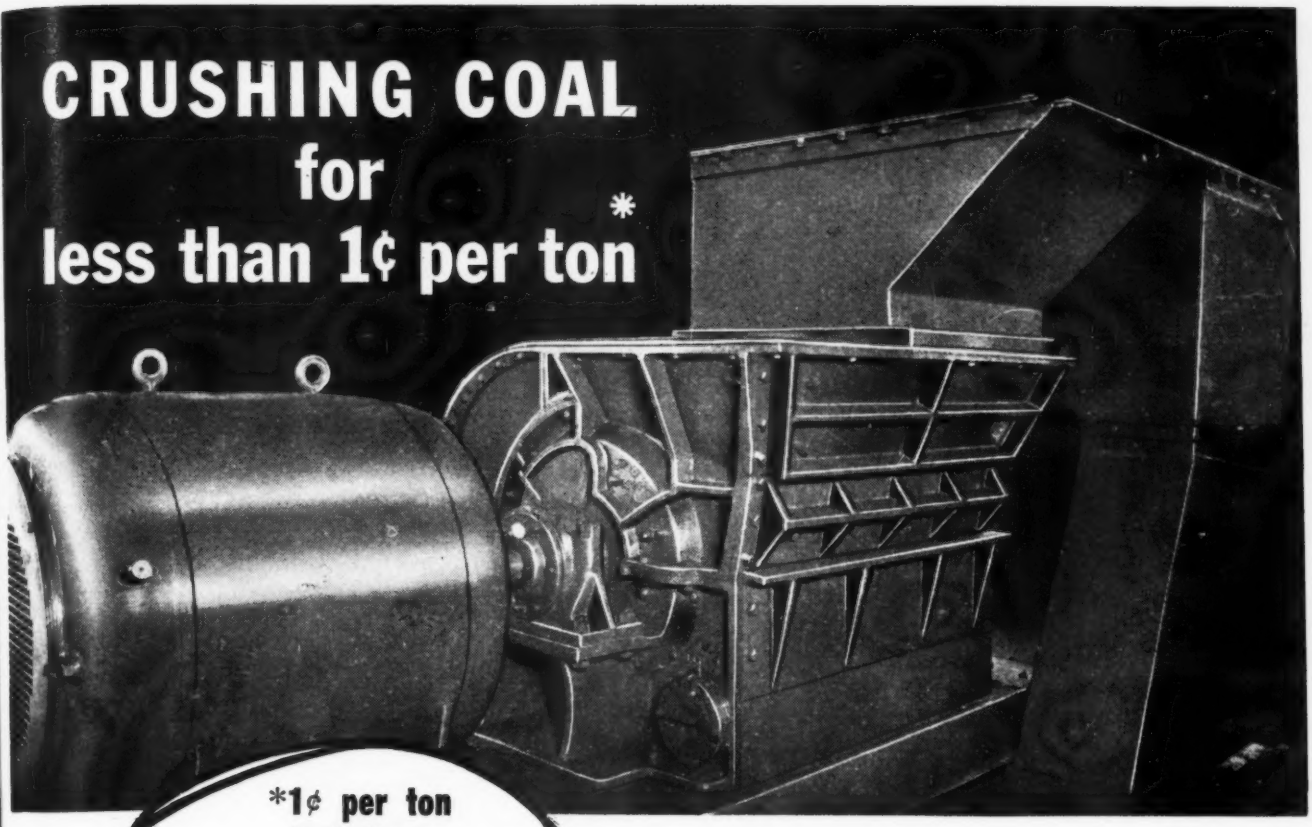
The savings that result from removal of entrained oil, water, dirt and scale, justify full and proper use of Swendeman Separators. Air tools and machines operate better and last longer with less maintenance: spray painting, drying, cleaning and other operations call for the use of clean dry air, if the work is to be performed satisfactorily. Power is often saved, and compressors work at higher efficiency when the air stream is relieved of the dead weight of water. Air lines are less liable to costly breakdown due to rusting, clogging and freezing.

So . . . it should pay you to have a Swendeman Engineer go over your air system and make recommendations. The cost of the apparatus is moderate, and actual installation is not at all complicated. Why not look into it now — *and be ready when the great Day comes!*

SWENDEMAN
Automatic Separator
A DEXTER PRODUCT

The **LEAVITT**
MACHINE COMPANY
ORANGE, MASSACHUSETTS

CRUSHING COAL for less than 1¢ per ton*



*1¢ per ton includes:
Maintenance
Power, Labor
Interest on Investment
Depreciation

. . . an everyday achievement in many leading plants with

AMERICAN RING CRUSHERS

Low cost of crushing the "AMERICAN WAY" is not the result of ideal conditions existing at one plant or is it an exceptional achievement. It is actually a *universal* accomplishment based on the average performance records of many plants and can therefore be accepted as a safe, conservative estimate of the cost you can reasonably expect by putting the "AMERICAN" to work for sizing coal to meet your particular requirements.

There is sound reason for this low-cost crushing with "AMERICANS." Centrifugal force, applied at right angles to a horizontal shaft, causes rings in suspension to strike material entering from the top, with the result that coal is shattered and split before reaching breaker and grinding plates. Sizing to specific requirements is effected by a simple adjustment of patented grinding plate of long-wearing manganese steel. These features of the "AMERICAN" make it possible to crush coal (run of mine or lump size) and size it exactly as required for stoker or pulverized fuel needs in one easily controlled, low-cost operation.

Constructed of heavy, reinforced steel castings, lined with manganese steel sections, and designed to be self-acting against tramp material, cost of maintenance is remarkably low.

Made in capacities from 25 to 500 tons per hour.
Investigate today by sending for complete information.

AMERICAN PULVERIZER COMPANY 1349 MACKLIND AVENUE ST. LOUIS, MISSOURI

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

4 reasons why Gulfcrest Oil LEADS THE FIELD

1 **REFINED BY THE ALCHLOR PROCESS.** The most thorough and effective method for removing chemically active or unstable hydrocarbons as well as other impurities present in all crudes.

2 **HIGHEST RESISTANCE TO OXIDATION.** Because this famous ALCHLOR Process synthesizes and rearranges the molecular structure of certain hydrocarbons more susceptible to chemical change in service, the finished oil has greater stability. GULFCREST OIL stands alone in its high resistance to oxidation.

3 **HIGHEST RESISTANCE TO THE FORMATION OF ORGANIC ACIDS AND SLUDGE.** Because of the elimination or rearrangement of the less stable hydrocarbons, the unparalleled refining power of Alchlor Process provides oils that form less gum and deposits, less sludge, and a higher resistance to emulsification when mixed with water, insuring years of uninterrupted service.

4 **MAXIMUM K.W. OUTPUT PER UNIT OF CONSUMPTION.** Because the Alchlor Process not only makes possible an oil more highly refined and homogeneous but with a greater resistance to oxidation and deterioration, longer life is insured and less make-up oil is required.

Gulfcrest Oil has the two important assets you want in a turbine lubricant: *superior lubricating value, longer life!*

These assets are the result of more thorough and more complete refining. For Gulfcrest Oil is not only refined by conventional methods, but is super-refined by the Gulf Alchlor Process, the most effective method for producing a turbine oil with maximum resistance to oxidation and sludge. Gulfcrest Oil is the world's finest turbine lubricant!

Call in a Gulf Lubrication Service Engineer and ask him to show you how Gulfcrest Oil can help you get improved lubrication and higher operating efficiency. Write, wire, or phone your nearest Gulf office today.

GULF INDUSTRIAL LUBRICATION

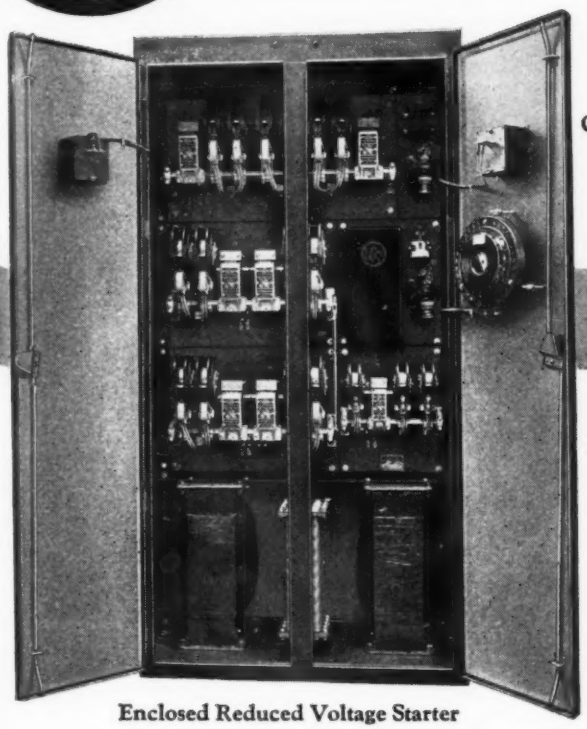
Gulf Oil Corporation · Gulf Refining Company
Gulf Building, Pittsburgh 30, Pa.

BACK THE ATTACK . . . BUY MORE WAR BONDS

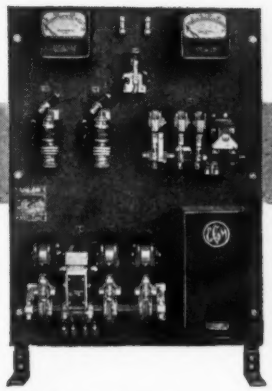
SYNCHRONOUS STARTERS FOR 220-550 VOLT MOTORS

•

Companion Line to Bulletin 1075-A, Oil-immersed Starters



Enclosed Reduced Voltage Starter



Standard Open Starter for Full Voltage Starting

AIR-BREAK TYPE WITH *LINE-ARC* CONTACTORS

D-C AUTOMATICALLY APPLIED TO FIELD BY ELECTRONIC RELAY

Above view shows field-switching contactor at right. This has one normally-closed and two normally-open contacts. At the left is easily adjustable, electronic-type relay which applies direct current to motor field to pull motor into synchronism automatically.

THESE are completely wired units, each with line and field ammeters, overload relays, mounting of exciter-field rheostat, auto-transformer (on reduced voltage starters), etc.

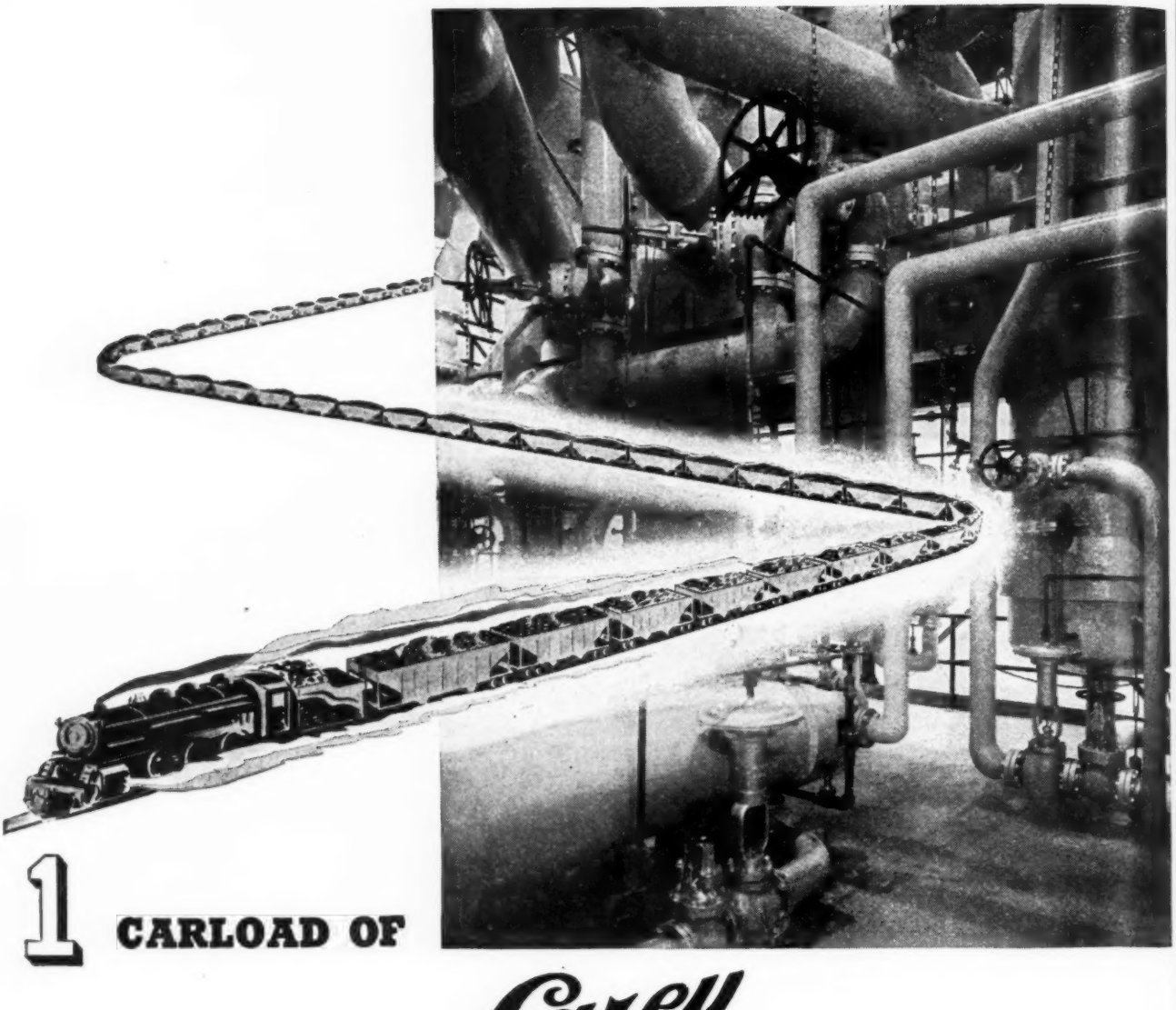
They are arranged for two or three phase service. Maximum ratings—(for both reduced and full voltage starting) 400 H.P., 220 volts and 800 H.P., 440 and 550 volts.

Standard features include equipment as illustrated and described above. Optional features include enclosures; disconnect switch; and when enclosures are desired for starters having this disconnect feature, space for 3-phase bus is provided at the top of the enclosure. Other options are indicating light; field-removal with automatic resynchronization should motor pull out-of-step, etc.

Complete details are given in Bulletin 1076-A. Ask for your copy to-day.

EC&M COMPLETELY AUTOMATIC— — SYNCHRONOUS STARTERS

THE ELECTRIC CONTROLLER & MFG. CO., Cleveland 4, Ohio



1 CARLOAD OF Carey HEAT INSULATION

SAVES 80 TO 100 CARLOADS OF COAL ANNUALLY

CAREY Insulation is so efficient in resisting passage of heat that one 15-ton carload, applied to exposed hot surfaces, can save 80 cars of coal, of 40 tons each, per year.

At this time, when you need to produce every possible kilowatt from every ton of fuel, it is important that generating equipment be thoroughly checked for heat losses. If improvement in efficiency is attainable through thicker insulation, or a more suitable type, you'll find such improvement extremely profitable.

CAREY Insulations usually return their cost in savings in a few months, then continue paying big annual dividends for many years.

Whatever your insulation needs, you're SAFE with CAREY. A nation-wide organization is at your service. Write Dept. 16 for details.

THE PHILIP CAREY MFG. COMPANY

Dependable Products Since 1873

Lockland, CINCINNATI, OHIO

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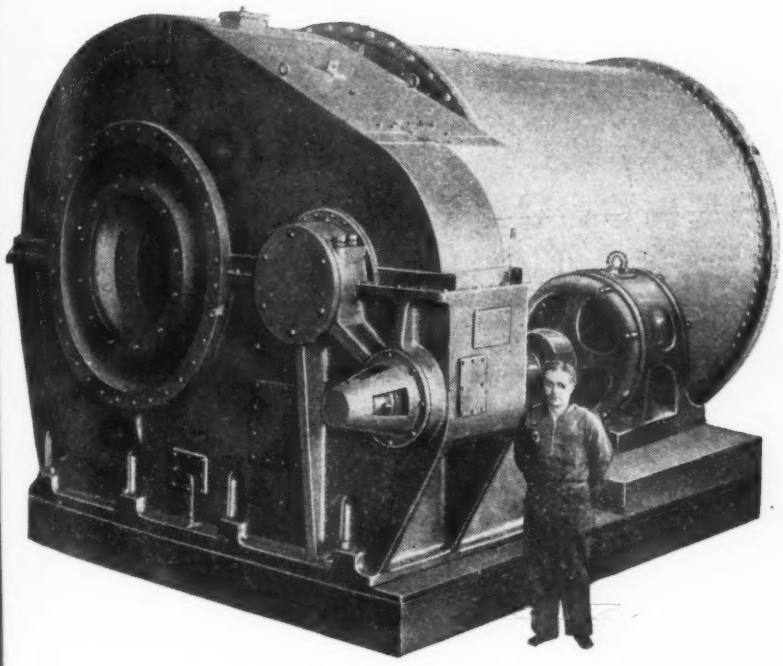
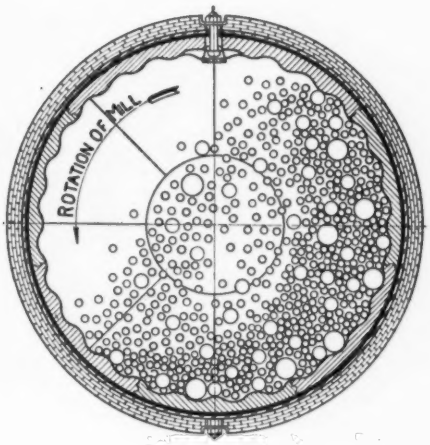
LOOK INTO THIS!

THE KENNEDY AIR SWEPT TUBE MILL INSURES

FINE PULVERIZATION...

. . the Key to burning lower grade coal





Inside of Tube Mill, showing cascading balls which pulverize the coal between thousands of spherical grinding surfaces. The hardest grade of abrasive coal is pulverized by using hardened steel balls.

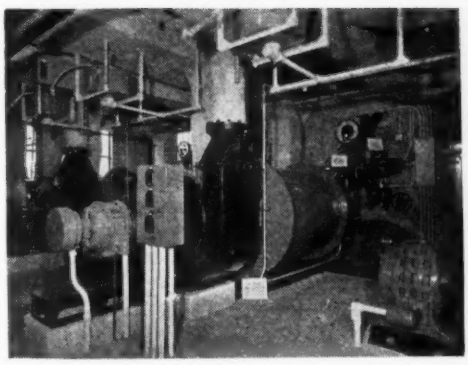
THE KENNEDY AIR SWEPT TUBE MILL will produce pulverized coal continuously at 85 to 95% through 200 mesh screen. Grinding quality is not affected by wear due to coal abrasion. It is maintained at the level of a new mill by occasionally adding a few balls of larger size, while running, to compensate for those worn in grinding. Tramp iron is not injurious to the mill, it aids in grinding, replacing an equal amount of ball wear.

Silent double reduction herringbone gears are totally enclosed and built integral with the mill, with roller bearings and automatic lubrication.

This mill has a low maintenance cost and a high "in service" factor. Many have run continuously for 11 months between annual inspections.

• COMPLETE ENGINEERING

Kennedy-Van Saun offers a complete steam power plant service, including steam generating units, pulverizing equipment, burners, fans, coal elevators, bunkers, coal weighing scales, ash conveyors, and related equipment. Ask for complete details. Let our engineers help you with the special problems that exist in your plant. Write for our Bulletin No. 12 on Pulverized Coal.



Part of a bank of Kennedy Air Swept Tube Mills in an Eastern Utility, producing 1,000,000 lbs. of steam per hour.

ARMY-NAVY E

Kennedy Products

Kennedy-Van Saun

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2 PARK AVE., NEW YORK 16, N. Y.

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"WE BEND OVER BACKWARDS TO PLEASE YOU"

Flori's Fabricated Piping is "custom built," complete and ready to install, for any use.

We can make anything in tubular and plate steel fabrication — and we will! Try us.

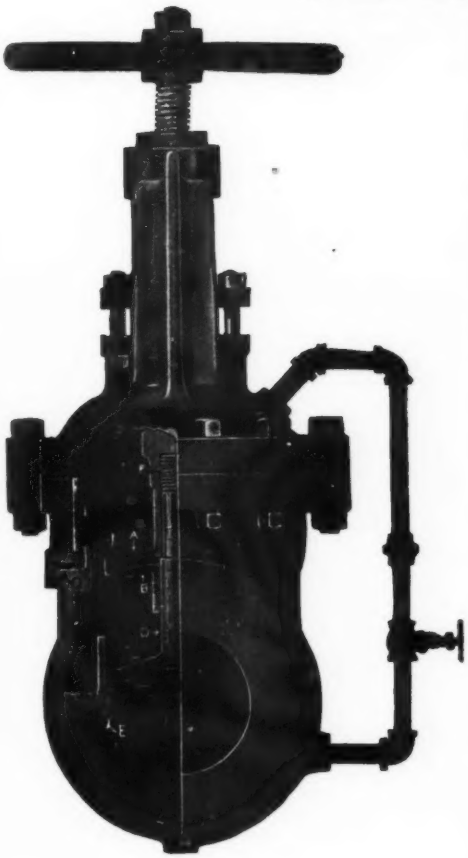
A WAR-BUSY PLANT

NOW SUPPLYING COMPONENT PARTS AND COMPLETE SYSTEMS FOR INVASION BARGES, TANKERS, CARGO VESSELS, AIRCRAFT, TANKS AND ORDNANCE.

FLORI PIPING

THE FLORI PIPE COMPANY, ST. LOUIS — CHICAGO

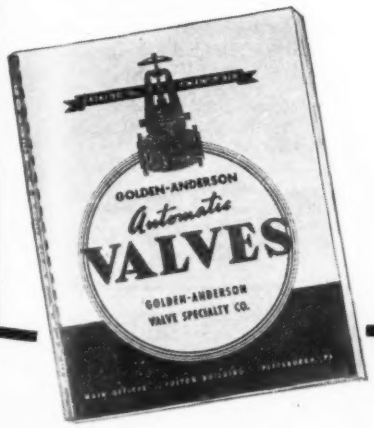
Golden Anderson SPECIALTY VALVES



Here is instantaneous automatic protection against runaway engines and turbines

• The Golden-Anderson Throttle and Emergency Stop Valve shown here offers positive protection against runaway engines and turbines. It works instantly . . . mechanically, electrically, by hand or remote control. No unit can exceed safe operating speed when equipped with this unit.

The valve is supplied in angle and globe patterns from 2½" to 16" sizes. Valve trim may be bronze, monel, stainless steel or Gallavoy, according to pressure and temperature conditions. Seat rings and disc may be stellited.



Write today for this catalog . . . describes the complete line of G-A Specialty Valves.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

FULTON BLDG. PITTSBURGH, PA.

CARDOX

FIRE PROTECTION Here...

Can Mean More FIRE POWER For The Hard Fight Ahead

One major fire in a war industry—or a small fire that results in crippling damage by the extinguishing medium—may deprive our fighting forces of vital equipment.

For those critical hazards where fire *could* stop all production, *might* destroy your entire plant. Cardox Fire Extinguishing Systems afford maximum protection.

HOW CARDOX SYSTEMS PERFORM

You can protect one or numerous hazards of like or diverse nature with a Cardox System. Tons of liquid CO_2 maintained at a controlled low temperature in a single storage unit . . . released in timed, mass discharge through built-in piping systems . . . smother the fire and cool combustibles below re-ignition temperature. So rapidly is the Cardox CO_2 discharged—in tons for large fires, in pounds for small ones—that the actual burning time can be cut down to a very few seconds.

Because there is no damage by the extinguishing medium, men and machines are back at work quickly.

Cardox Systems are preventing interruption to vital war production by fires in such key industries as: Airplanes, Airplane Parts, Armor Plate, Aviation Carburetors, Aviation Engines, Cold Strip Steel, Electric Power, Engine Parts, Forgings, Motor Fuel, Plastics, Processed Fabric, Rubber Products, Solvents, Tanks, Tank Engines.

If you would like more detailed information on how Cardox Systems provide engineered fire protection for large or small fire hazards—indoors or out—write on your company letterhead for Bulletin No. 9.

★ ★ ★

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS

District Offices in New York • Washington
Detroit • Cleveland • Atlanta • Pittsburgh
San Francisco • Los Angeles • Seattle

How Cardox Systems Protect War Industries

- Timed discharges, as needed, through built-in piping systems . . . supplied instantly from a single storage unit holding tons (if required) of liquid Cardox CO_2.
- Mass discharge of Cardox CO_2 "knocks out" fire, by . . .
- Reducing oxygen content of the atmosphere below the concentration necessary for combustion, and . . .
- Cooling combustibles and fire zone below ignition temperature . . .
- Extinguishing fire quickly and completely *without* damage from extinguishing medium.

CARDOX—CO_2 Systems with Enhanced Fire Extinguishing Performance

A. Uniformity of CO_2 characteristics.
B. Extinguishing medium with uniformly greater cooling effect.
C. Accurate projection of CO_2 through greater distances.
D. Timed discharges, as needed, through built-in piping systems . . . supplied quickly from a single tank holding tons of liquid Cardox CO_2.

MASS DISCHARGE OF CO_2 · ENHANCED COOLING EFFECT · CENTRAL STORAGE UNIT · AMPLE CO_2 RESERVE · ENGINEERED SYSTEMS · MANUAL OR AUTOMATIC CONTROL

CARDOX

NON-DAMAGING FIRE EXTINGUISHING SYSTEMS

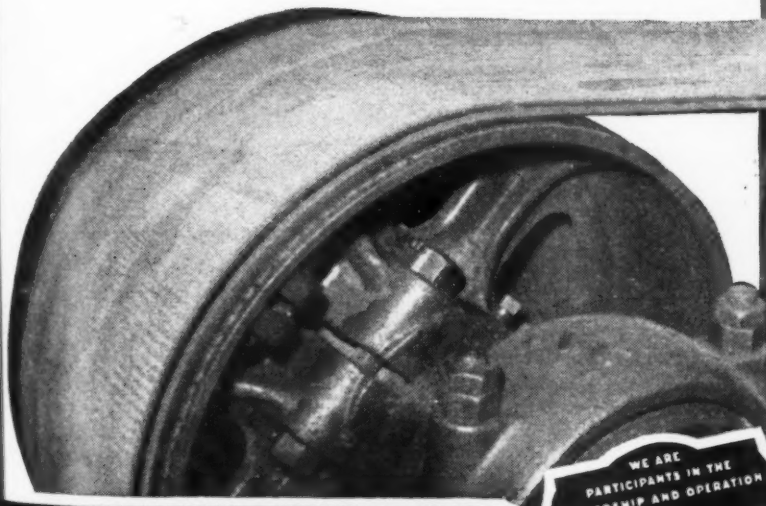
Nearby Matériel Base for RUBBER

World War II has drawn a parallel between successful military and wartime industrial activities —the advantages of bases close by the field of operations and the necessity of active supply lines. Mill supply distributors provide these bases for American industry and help maintain lines of supply from factory to industrial user.

Republic Rubber Distributors, located in every section of the United States, keep stocks and furnish valuable supply and maintenance service wherever rubber hose, belting, packing and other mechanical rubber products are used. Close factory and technical cooperation with Republic augments the services your Republic Distributor has to offer. Consult with him confidently on your requirements for mechanical rubber products.

Accredited Distributor

See your Republic Distributor



WE ARE PARTICIPANTS IN THE OWNERSHIP AND OPERATION OF NATIONAL SYNTHETIC RUBBER CORPORATION

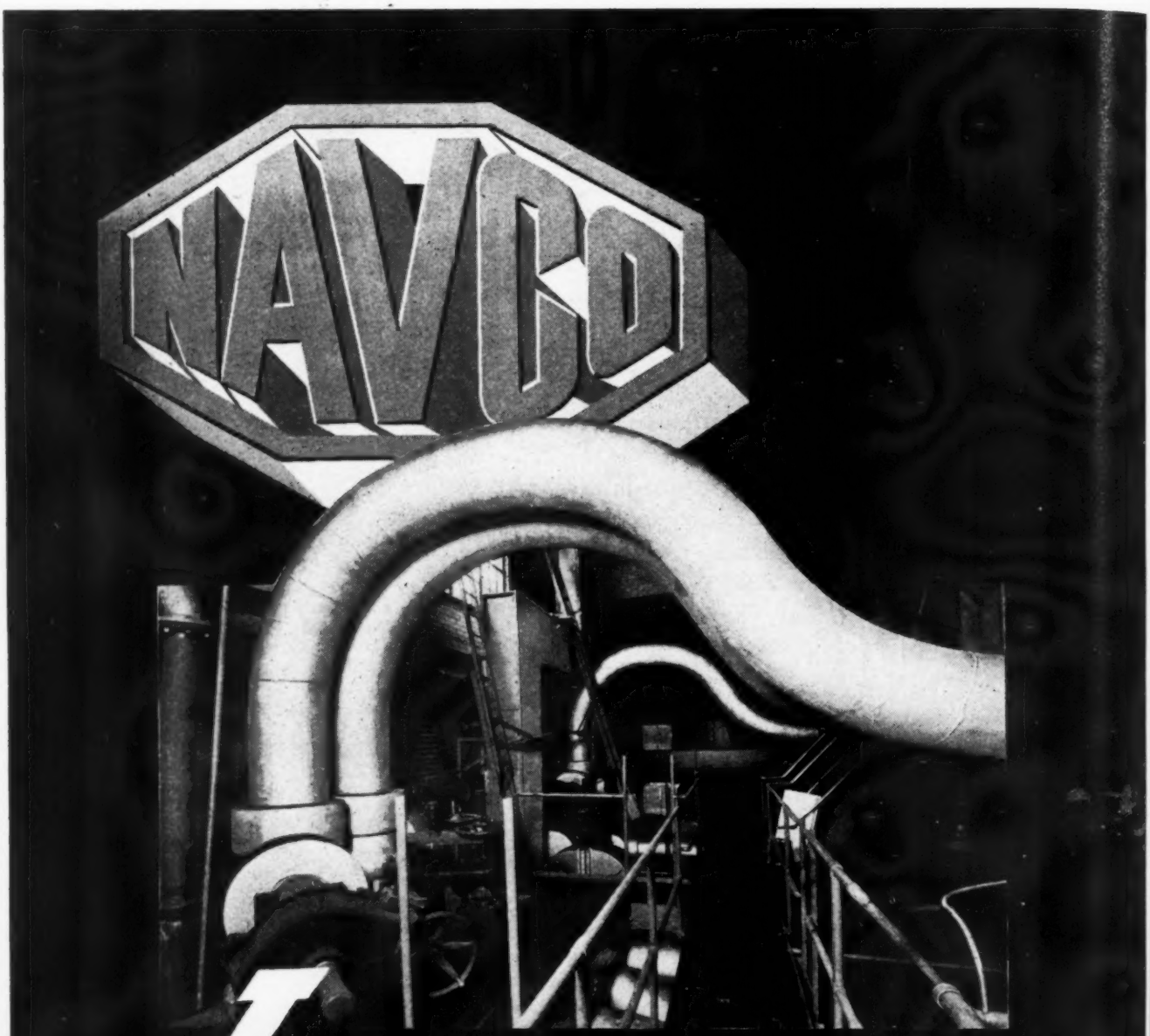
REPUBLIC RUBBER

YOUNGSTOWN 1 • • OHIO

HOSE • BELTING • MOLDED GOODS • PACKING • EXTRUDED PRODUCTS

DIVISION OF

LEE RUBBER & TIRE CORPORATION



Insignia of Strength and Service in Power Piping

NAVCO

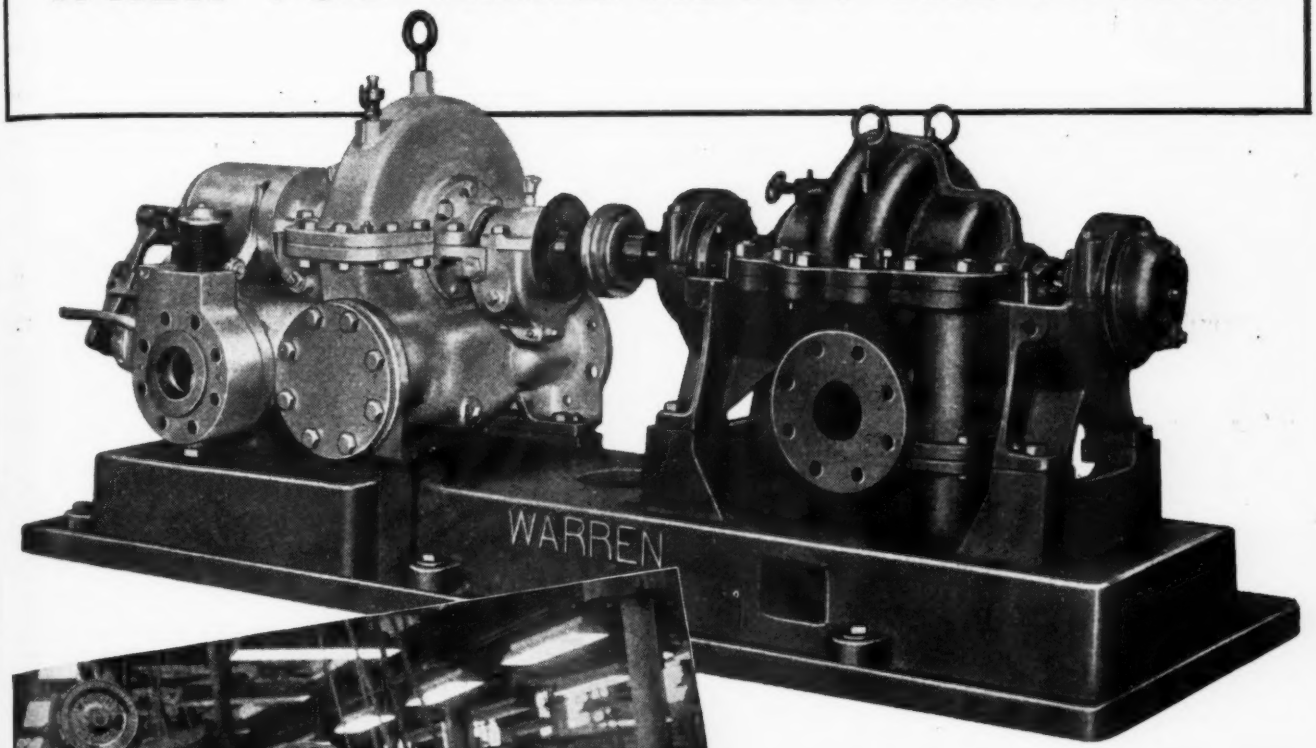
NAVCO PIPING

NATIONAL VALVE & MFG. CO., Pittsburgh, Pa.

ATLANTA • BUFFALO • CLEVELAND • CHICAGO • NEW YORK • PHILADELPHIA

Here's a Warren Pump to think about

WHEN YOU THINK ABOUT THE FUTURE



Meet Archie Albert, highly skilled Warren employee . . . and foreman of the Warren Engine and Small Turret Lathe Department. Archie's been with Warren for 21 years . . . is very proud of Warren pumps and their reputation for reliable, economical performance. He's proud, also, as all of us are — of the Warren Army-Navy "E" Award.

This Warren Centrifugal Pump is being made for commercial purposes in limited quantities, now

Warren Two Stage Volute Centrifugal Pumps have been carrying their share of the load in the war effort because of their unusual stamina, low maintenance cost and reserve capacity. They are well worth considering *now* for post-war work.

One of the design features concerning these Warren Pumps which has a direct bearing on their low maintenance cost is the fact that they are *hydraulically balanced*. Stages are arranged so that one stuffing box is under suction pressure and the other is subject to only the first stage pressure. A separate interstage loop permits efficient connection between the two stages.

Other features include, liberal clearances between impeller and case rings . . . extra-heavy shafts . . . over-size bearings . . . carefully proportioned liquid passages. Write for Bulletin 229.

ARMY E NAVY

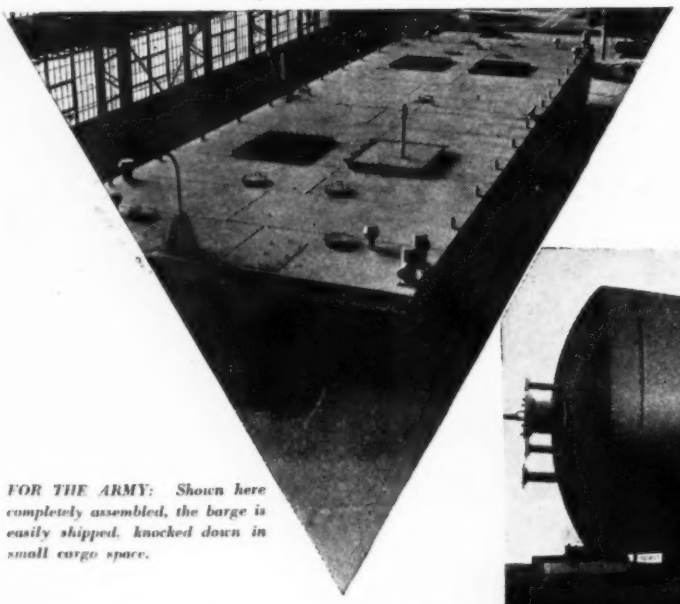
WARREN STEAM PUMP CO., INC.

WARREN, MASSACHUSETTS

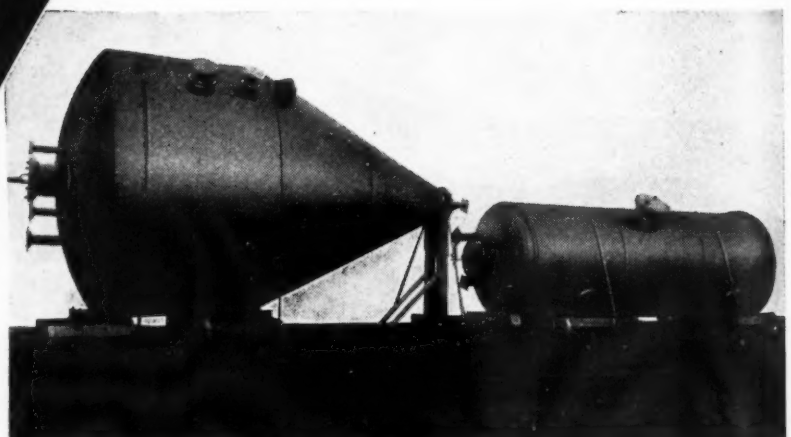
"MAIL-ORDER" BARGES FOR THE BATTLEFRONTS

This huge steel barge is transported in sections to a battle area, where it can be assembled and set afloat quickly and easily. Pre-fabricated in the GATX plant at Sharon, it is another example of our widely diverse, often unprecedented, production accomplishments during this war.

Along with this and many other types of war equipment, we are building the GATX know-how—the broadened experience, the improved methods that will mean postwar economies for you.



FOR THE ARMY: Shown here completely assembled, the barge is easily shipped, knocked down in small cargo space.



FOR INDUSTRY: General American makes pressure vessels of all types, for use in production tansportation and storage.

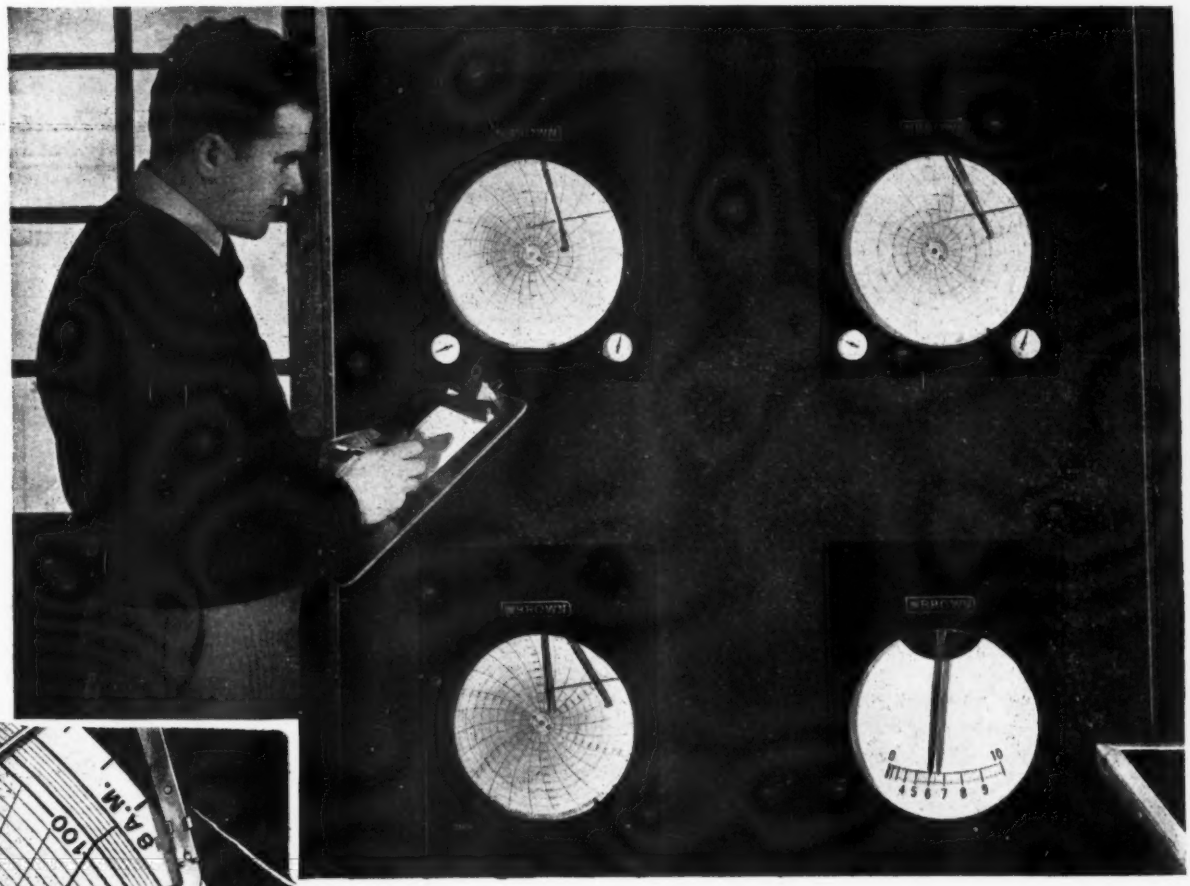
Building for today's fighters—Planning for tomorrow's builders

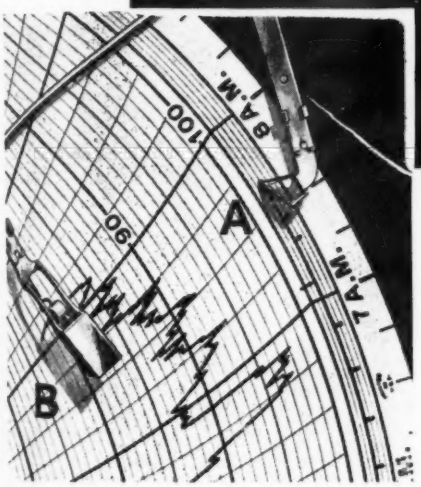
GENERAL AMERICAN TRANSPORTATION CORPORATION

GATX GENERAL AMERICAN PLATE & WELDING DIVISION PLANT AT SHARON, PA.

Plate & Welding Division — Sharon, Pennsylvania

"Specialists in plate fabrication—manufacturers of pressure vessels of steel, alloys and aluminum—all classes of welding—process equipment of all types—chemical engineering laboratories and service—completely equipped field erection department."





These records are your receipt for every dollar spent for fuel

Automatic planimeter pen record "A" shows steam flow in volume units and the time at which it was produced or used in any part of the 24-hour period, enabling you to easily analyze steam production and distribution.

Record line "B" shows rate of flow and enables the operators to maintain the most efficient boiler operation, thus effecting substantial fuel savings.

Why You Should Use Flow Meters

Steam costs are important costs—Do you know *what* you are getting for these costs? Do you know *where* it is going? Knowing this, you can make substantial savings not only in the boiler room but in every department or unit where steam is used.

This double saving is made possible by the dual records on every Brown Steam Flow Meter Chart.

With Brown Flow Meters, you can correctly determine the cost of making steam for power, processing or heating and properly allocate costs to departments or units. Brown Flow Meter chart records reveal instantly any deviation above or below the most efficient operating standards of steam generation and distribution.

Thousands of steam engineers are getting this kind of service from Brown Flow Meters. They are easy to install—parts are simple and few. In many plants, the investment for Brown Flow Meters has been repaid many times over. Learn more about them. Write for Catalog No. 2008.

THE BROWN INSTRUMENT COMPANY

4490 Wayne Avenue, Philadelphia, Pennsylvania

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY MINNEAPOLIS, MINNESOTA

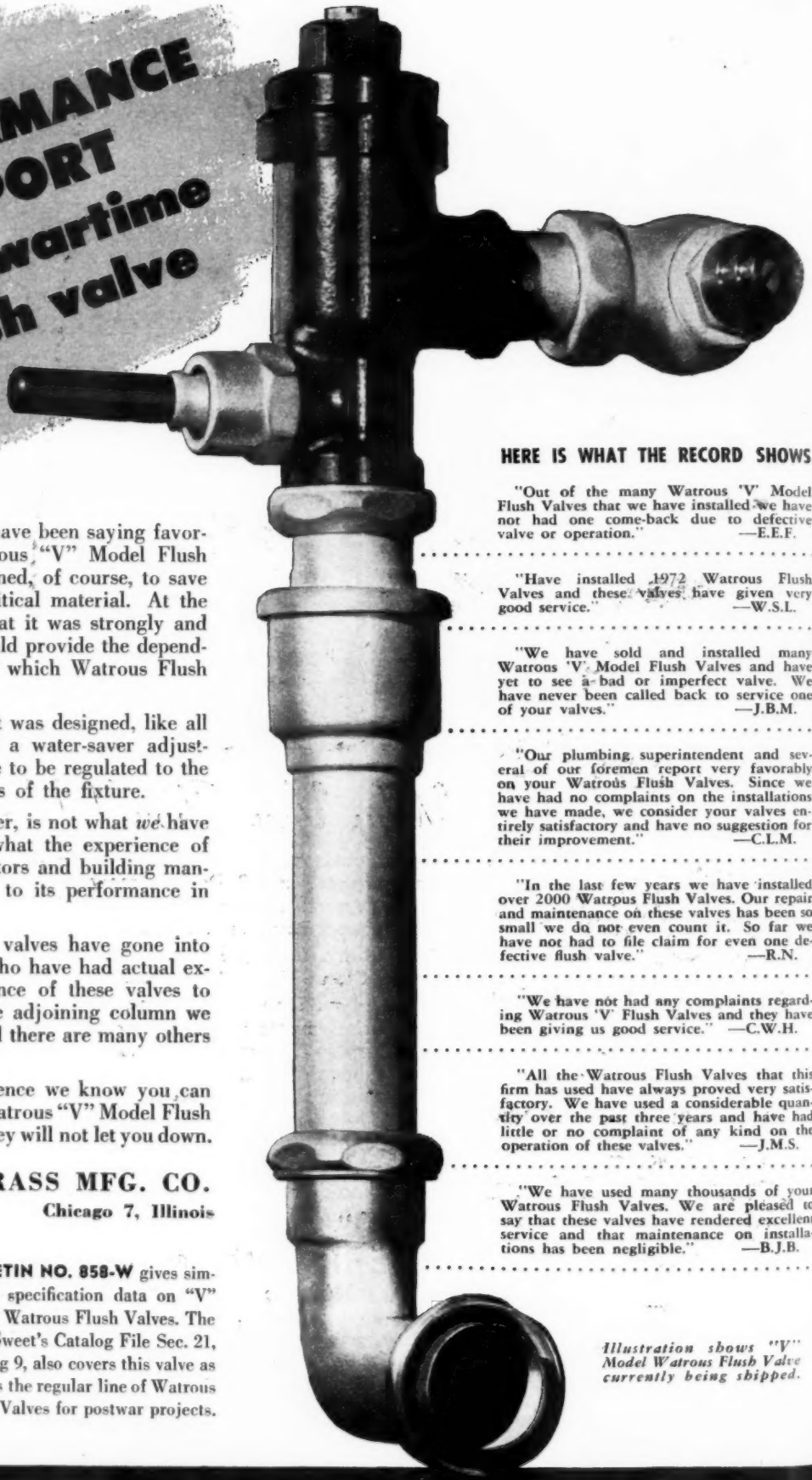
Offices in all principal cities. 119 Peter Street, Toronto, Canada—Wadsworth Road, Perivale, Middlesex, England — Nybrokajen 7, Stockholm, Sweden

BROWN FLOW METERS

. . . MINNEAPOLIS - HONEYWELL CONTROL SYSTEMS . . .

To Measure and Control is to Economize

PERFORMANCE REPORT on a wartime flush valve



For more than a year we have been saying favorable things about our Watrous "V" Model Flush Valve. This valve was designed, of course, to save the maximum amount of critical material. At the same time, we made sure that it was strongly and durably built and that it would provide the dependable, trouble-free service for which Watrous Flush Valves are famous.

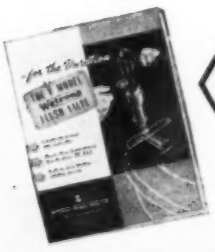
As we have pointed out, it was designed, like all Watrous Flush Valves, with a water-saver adjustment which enables the valve to be regulated to the minimum water requirements of the fixture.

The big point here, however, is not what *we* have said about this valve, but what the experience of architects, plumbing contractors and building management men has shown as to its performance in the field.

Many thousands of these valves have gone into service and we asked men who have had actual experience with the performance of these valves to report their findings. In the adjoining column we list some of these reports and there are many others —*all* favorable.

From this and other evidence we know you can safely recommend and use Watrous "V" Model Flush Valves with assurance that they will not let you down.

THE IMPERIAL BRASS MFG. CO.
514 S. Racine Ave. Chicago 7, Illinois



BULLETIN NO. 858-W gives simplified specification data on "V" Model Watrous Flush Valves. The 1944 Sweet's Catalog File Sec. 21, Catalog 9, also covers this valve as well as the regular line of Watrous Flush Valves for postwar projects.

HERE IS WHAT THE RECORD SHOWS

"Out of the many Watrous 'V' Model Flush Valves that we have installed we have not had one come-back due to defective valve or operation." —E.E.F.

"Have installed 1972 Watrous Flush Valves and these valves have given very good service." —W.S.L.

"We have sold and installed many Watrous 'V' Model Flush Valves and have yet to see a bad or imperfect valve. We have never been called back to service one of your valves." —J.B.M.

"Our plumbing superintendent and several of our foremen report very favorably on your Watrous Flush Valves. Since we have had no complaints on the installations we have made, we consider your valves entirely satisfactory and have no suggestion for their improvement." —C.L.M.

"In the last few years we have installed over 2000 Watrous Flush Valves. Our repair and maintenance on these valves has been so small we do not even count it. So far we have not had to file claim for even one defective flush valve." —R.N.

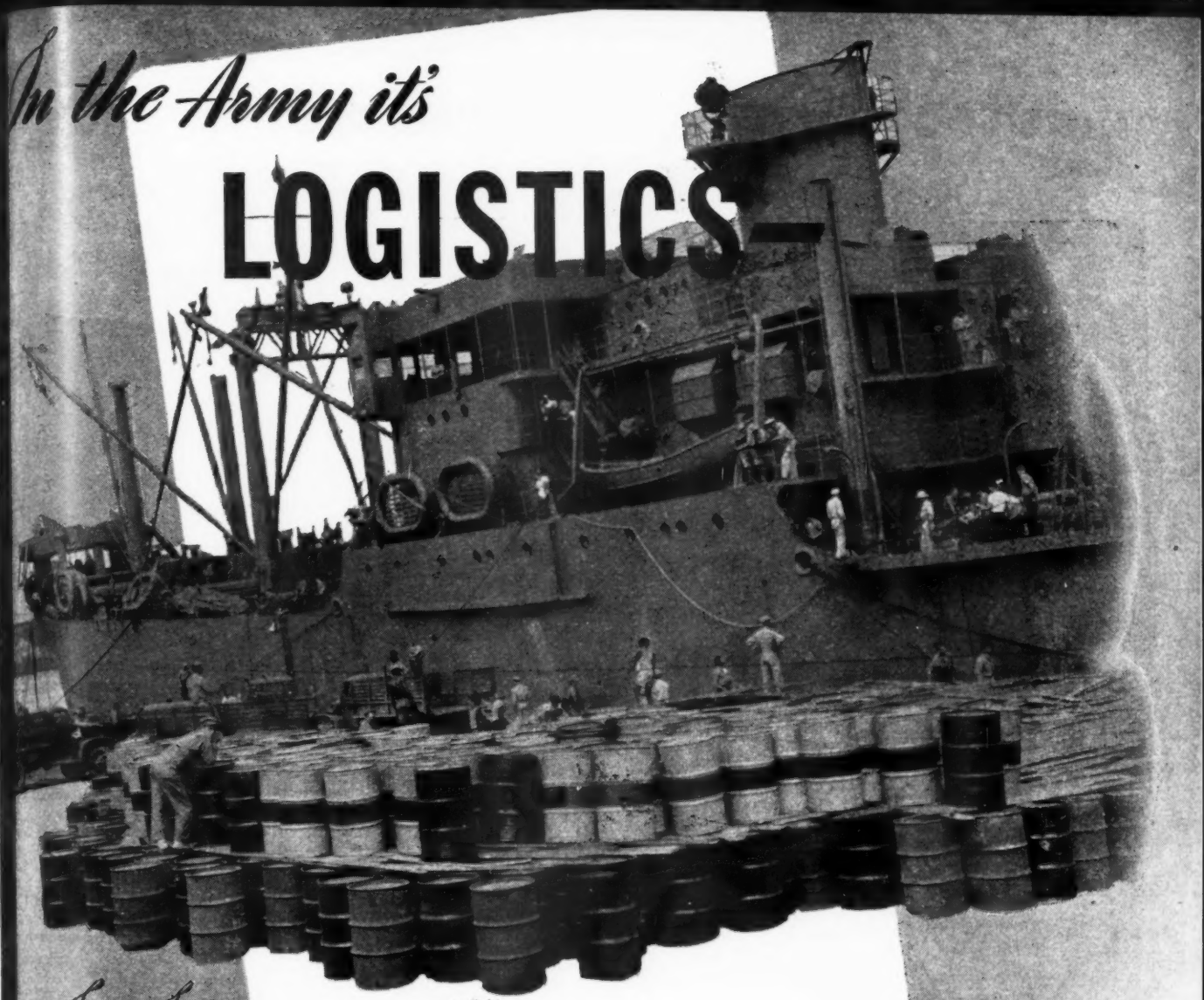
"We have not had any complaints regarding Watrous 'V' Flush Valves and they have been giving us good service." —C.W.H.

"All the Watrous Flush Valves that this firm has used have always proved very satisfactory. We have used a considerable quantity over the past three years and have had little or no complaint of any kind on the operation of these valves." —J.M.S.

"We have used many thousands of your Watrous Flush Valves. We are pleased to say that these valves have rendered excellent service and that maintenance on installations has been negligible." —B.J.B.

Illustration shows "V" Model Watrous Flush Valve currently being shipped.

Watrous Flush Valves



In the Army it's

LOGISTICS—

In Industry it's

MATERIAL HANDLING

Getting the RIGHT Material to the RIGHT Place at the RIGHT Time!

• In the army the supply lines are ships, trains, trucks and planes. In industry, they are conveyors and elevators, engineered into efficient material handling systems.

The development of such systems is a job at which Stephens-Adamson has specialized for 42 years. This broad design and manufacturing experience is at your service now—to help you secure a system that will assure fast, safe and economical conveying and elevating of any kind of bulk materials. For the solution to your present or anticipated material handling problems, call on S-A.

STEPHEN S-A ADAMSON

MFG. CO.

RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT

NINE FOOT TWO . . . SEAMLESS . . . TRUE

Another example of Taylor Forge "know-how" that means extra value in WeldELLS

Turning out a 110" O.D. SEAMLESS Steel Flange to rigid specifications of accuracy isn't exactly the easiest job in the world. But tough jobs are not unusual here at Taylor Forge. In fact, this one is quite typical of the kind that is so often assigned to us by engineers who feel we are a little better at it than any other organization.

For a good many years these "unusual" things have been the usual at Taylor Forge . . . doing things with hot metal that nobody else does . . . knowing just how to control its flow and form under pressure and impact.

And in the final analysis there is no better example of this than your old friends WeldELLS and other Taylor Forge welding fittings themselves. For while WeldELLS represent our regular line of welding fittings, they reflect forging operations that are *far* beyond the usual!

Check down the list of WeldELL features and you will see how true this is. Only Taylor Forge knowledge and methods could give you a fitting with tangents and selective distribution of metal in an extremely accurate, seamless forging! Add to this the features of WeldELLS which cut welding time and costs, and you have the fittings that . . . *"have everything"!*

No other welding fittings combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

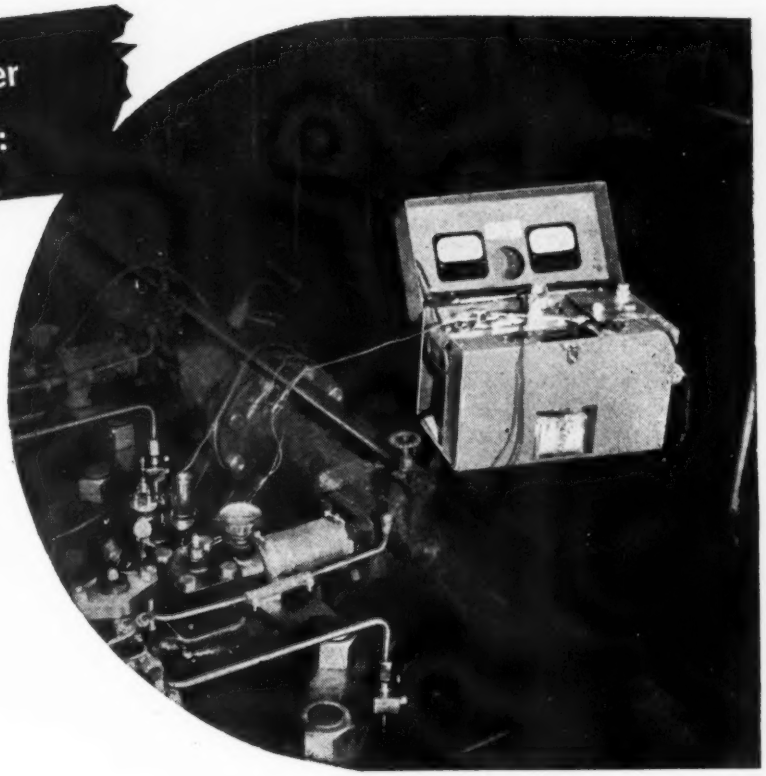
WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

Now...a new Engineering Service for Diesel Operators

Cities Service Diesel Heat Prover test checks these vital points:

1. **Individual cylinder H.P. output**
2. **Individual cylinder compression**
3. **Individual cylinder peak pressures**
4. **Fuel injection timing**
5. **Mechanical condition of piston and rings**
6. **Exact air fuel ratio**



WITH THE new Cities Service Diesel Heat Prover it is now possible for you to determine exactly the operating efficiency of your Diesel equipment and make any necessary adjustment long before trouble starts.

The Diesel Heat Prover reveals the degree of waste in the engine caused by air deficiency (excess fuel), or the degree of waste caused by dilution (excess air). Through unique means these conditions are measured correctly on the two Heat Prover dials. Readings are continuous.

Make sure your Diesels are in perfect working order. Mail the coupon today for a Heat Prover test of your equipment at no cost or obligation to you. (Available only in principal cities of Cities Service Marketing Territory East of the Rocky Mountains.)

"NOW ENGINES WORK IN PERFECT UNISON"

"Poor load distribution between our* Diesel engines was responsible for costly wear and maintenance expense. The Cities Service Diesel Heat Prover revealed this condition—enabled us to take corrective measures. Now engines work in perfect unison and share equally the load which fluctuates over as much as 40% range during certain types of yard operations."

** Name of company on request.*

CITIES SERVICE OIL COMPANY
Room 161
Sixty Wall Tower
New York 5, New York

Gentlemen: Please contact me regarding your Diesel Heat Prover test.

Name_____

Title_____

Company_____

Address_____

City_____ State_____

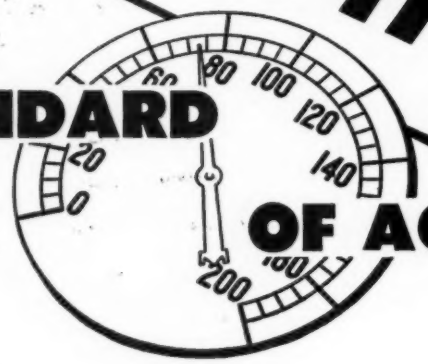
CITIES SERVICE OILS — ONCE-ALWAYS

CITIES SERVICE OIL COMPANY

ARKANSAS FUEL OIL COMPANY

MARSH

"THE STANDARD OF ACCURACY"



This isn't just our own appraisal!

For many years this expression has been associated with Marsh Gauges and Dial Thermometers.

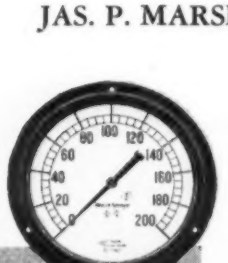
We call it an expression, rather than a slogan, because slogans are trumped up. This expression simply *came* up. We enclose it in quotation marks because it expresses the feeling of hundreds of users toward Marsh instruments. Marsh instruments *have* become the standard of comparison; Marsh *is* "the standard of accuracy".

When a product reaches such a position, few people ask how it got there. But if you ever take the trouble to check back over the many years during which Marsh has been making gauges, you will find that there is no mystery about it.

You will find that Jas. P. Marsh Corporation has not only shown the way in big developments, but has always given more attention to the small details . . . that count most. You will find, moreover, that this fidelity of detail is not confined to the more expensive instruments, but is common to all Marsh equipment in relation to the service for which it is built.

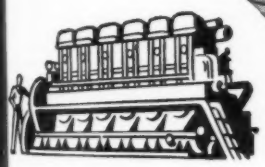
Why settle for less than the instruments that set the standard?

JAS. P. MARSH CORP., 2075 Southport Avenue, Chicago 14, Illinois



THE GAUGE WITH THE "RECALIBRATOR"

A gauge built to Marsh Standards is not likely to be knocked out of adjustment. But if it is, the Marsh "Recalibrator" will quickly restore its accuracy. Simply turn the "Recalibrator" screw until the pointer is at zero when not under pressure. The gauge will then be right at all points on the dial. Unlike other methods of resetting, the "Recalibrator" gets at the root of the error—re-establishes the relation of the bourdon tube to the movement—actually recalibrates the gauge.



Diesel performance doesn't start with the *Engine* but with the *Engineering!*

The economy, efficiency and dependability that you get in a Baldwin Diesel were put in long before the engine was built.

Its performance started back in the engineering department, where experienced diesel engineers work over countless sketches and intricate calculations to make sure that the engine will meet the specified requirements for power, efficiency and economy.

The extra dividend in performance from this fine engineering, shows up in Baldwin Diesels now serving in industry, on ships, and on locomotives *Make your next Diesel a Baldwin.* Locomotive & Ordnance Division, The Baldwin Locomotive Works, Philadelphia, Pa., U. S. A.

BALDWIN
PRODUCTS

Hydraulic presses • Testing equipment • Steel forgings and castings • Diesel-electric locomotives • Diesel engines • Metal plate fabrication • Rolled steel rings • Bronze castings • Heavy machine work • Crane wheels • Bending rolls • Plate planers • Babbitt metal • Alloy iron castings • Briquetting presses

BLW THE BALDWIN GROUP

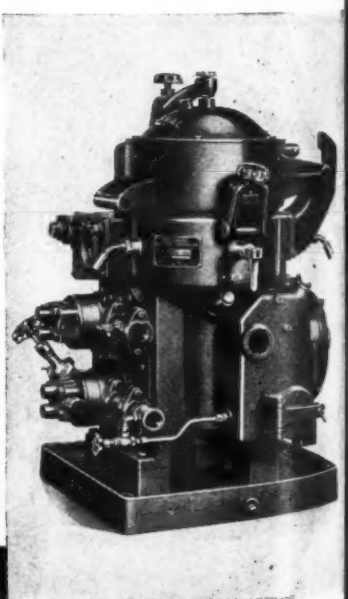
BALDWIN
DIESEL ENGINES

A DUTY TOUR THAT NEVER ENDS

WHEN the responsibility for keeping the oil used to lubricate power units in best possible condition is entrusted to De Laval "Uni-Matic" Oil Purifiers, you may rest assured that the trust will be well kept. These centrifugal machines will continuously and unfailingly protect your lubricating oil against contamination by water, dirt or other impurities that would impair its usefulness and eventually be reflected in serious operating trouble.

The De Laval "Uni-Matic" is a complete oil purifier, compact and fully enclosed. It includes pumps, gages, and all necessary accessories for keeping oil in the best possible condition. Machines are direct motor-driven, self-lubricated and ball-bearing equipped. The bowls in which purification takes place are self-draining and are scientifically rated as to efficiency to give Guaranteed Performance. Send today for additional details.

BOWLS of De Laval Oil Purifiers are of the "constant efficiency" type—the degree of purification is not affected by the removed sediment, which accumulates outside of the zone of separation.



THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York, 6 427 Randolph St., Chicago, 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco, 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

DE LAVAL OIL PURIFIERS

FOR LUBRICATING AND FUEL OIL

Plan for Today and Tomorrow

INSTALL ROCKBESTOS A.V.C.

IN CIRCUITS EXPOSED TO SEVERE OPERATING CONDITIONS

ROCKBESTOS A.V.C. 600 VOLT BOILER ROOM WIRE

(Underwriters' Type AVA)

Sizes No. 18 to 4/0 AWG. This construction for sizes 18 to 8, sizes 6 to 4/0 have another wall of felted asbestos next to the conductor.

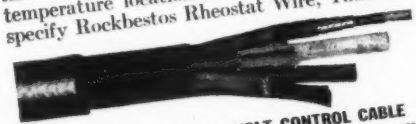
For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal. Also for locomotive panel wiring and for switchboards requiring an asbestos braided wire.

ROCKBESTOS 600 VOLT ALL-ASBESTOS RHEOSTAT CABLE

(Underwriters' Type AI)

Sizes No. 18 AWG to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For solid conductor specify Rockbestos Rheostat Wire, Table A.



ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

In one to 19 conductors. Standard stranding AWG No. 12—19/No. 25 and No. 9—19/No. 22. Other strandings furnished.

Designed for use under conditions too severe for control cables with other types of insulation which deteriorate rapidly when exposed to high temperatures. Operates without failure under the attack of heat, oil, grease or corrosive fumes and may be installed in conduit as it has ample moisture resistance.

Rockbestos A.V.C. 600 Volt Power Cable, illustrated*, No. 18 AWG to 1000 MCM, Underwriters' and N.E. Code, Type AVA, Maximum operating temperature 110°C., has this permanently insulated construction. (Also, with lead sheath and in voltage ratings up to 5000.)

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3. Lubricated varnished cambric for high dielectric strength and added moisture resistance, protected from heat and flame by two impregnated asbestos walls.

4. Outer impregnated asbestos wall which serves as a heat-barrier against high ambient temperatures.

5. A tough, rugged, impregnated asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.

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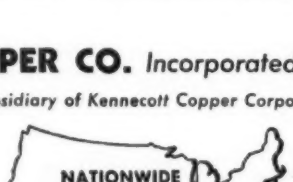

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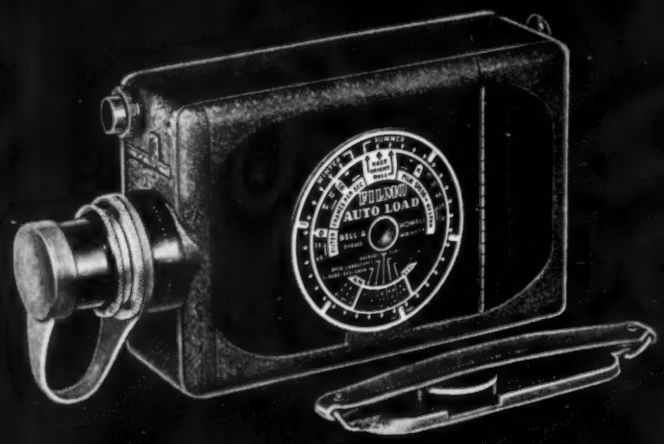

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Today the tremendous wartime demand for optical lenses has created an urgent need for new and highly specialized plants. In these plants Carrier engineering and equipment play a vital role.

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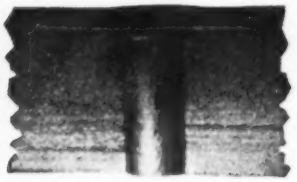
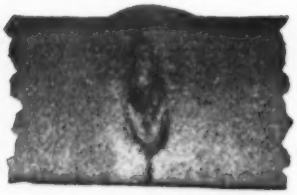


100% *penetration*



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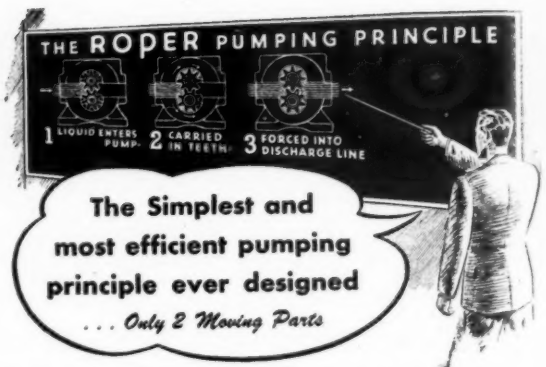

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. . . Only 2 Moving Parts

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SAVE FLOOR SPACE. Roper Pumps are designed to operate at direct motor speeds, thus eliminating gears, belts, etc. Roper "direct-drive" pumps require only 48% as much floor space as other models.

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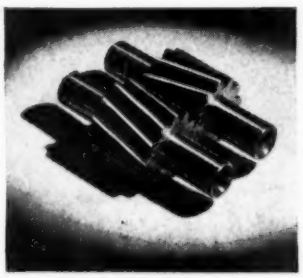

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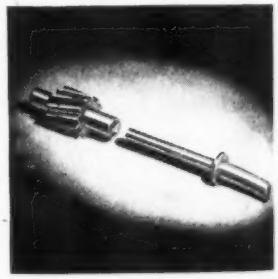
The only moving parts in Roper Rotary Pumps are these two equal size pumping gears. They operate in a case with just enough clearance to prevent wear.



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Entirely seperate from drive shaft, the pumping gears actually "float in operation". Any thrust or shock is absorbed by sliding joint and thrust collar.

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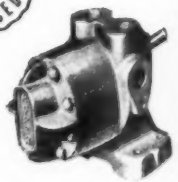

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There isn't much time to "baby" tube cleaners these days. They have to stand up under pressure. And the new 1300 Series Elliott Cleaners are doing just that, helped by a revolutionary lubrication system that saves bearings and increases power, plus the toughness imparted by the latest developments in metallurgy and heat treating.

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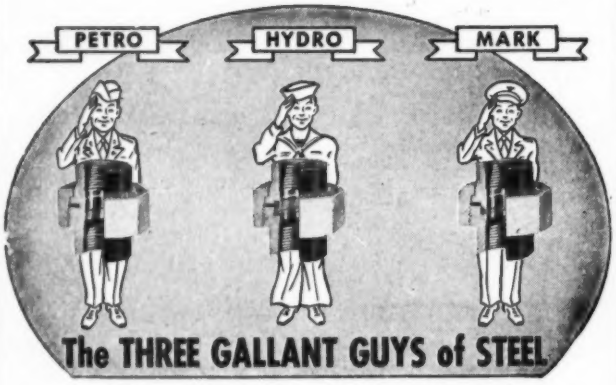

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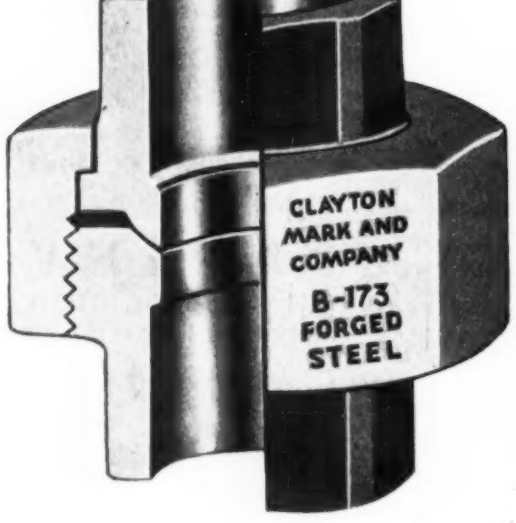

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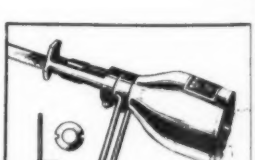
Jobs of sawing and cutting that are inaccessible to ordinary tools, are now made possible with the recently developed Saw-Gun. It works equally well on wood, plastics, light and heavy gauge metals (corrugated or plain—stainless and monel), castings, rods and other materials. The Saw-Gun saves hours on panel notching and slotting operations, doing work ordinarily requiring the use of several tools.

Permits sawing and filing in spots inaccessible to ordinary tools.

It is propelled by electric power, compressed air or flexible shaft and provides an efficient portable power-saw or file, that can be carried from place to place.

The Saw-Gun is operated by placing cutting edge of saw blade against work and turning on power. Filing is accomplished in the same manner by inserting a file in the tool instead of a saw blade.



Can be directly connected to electric drill, air drill, or flexible shaft.

We hope this has proved interesting and useful to you, just as Wrigley's Spearmint Gum is proving useful to millions of people (much to their surprise) working everywhere for Victory.

You can get complete information from the Mid-States Equipment Company, 2429 S. Michigan Ave., Chicago 16, Ill.

Y-106

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

What is the Life Expectancy of Your Condenser Tubing?

Authoritative appraisal of sample tube lengths by Bridgeport technicians can result in effective steps to reduce corrosion rate.

Much praise has come to industry for its excellent war production achievement made possible only through fine team work. Probably the hardest hitting member of this team is the group of steam power plants whose slogan seemingly is "The impossible takes a little longer."

Since power plants are too modest to speak for themselves, it is up to each of us to recognize the outstanding job which they are doing. Handicapped by serious transportation difficulties, fuel and labor shortages, limitations in the choice of condenser tube alloys and other problems, they are called upon to deliver power and steam to industry in unbelievable amounts and 'round the clock. How they were able to keep up with the insatiable demand for power is a story which will be written after the war.

Overwork can bring disastrous results to power plants as well as to individuals. We are all familiar with the fate of executives who carry too great a burden and suddenly fall by the wayside. A similar catastrophe can befall a steam power plant whose condensers suddenly fail through overwork and resulting excessive corrosion. Many plants are no doubt much overloaded. They do not find the opportunity to clean the tubes as often as is necessary, consequently, the corrosion rate may be higher than usual. If they do not watch out, some of their condensers are apt to fail much sooner than expected. To forestall unexpected failures in men as well as in machines, it is advisable to have a frequent physical check-up. A number of plants are doing just this thing.

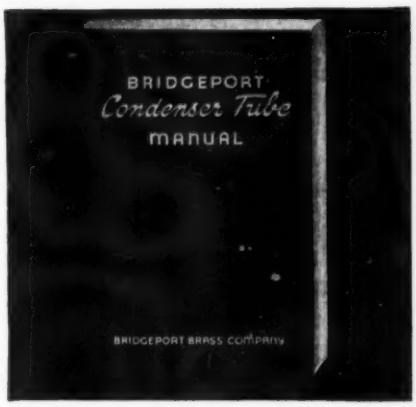
Our Laboratory receives frequent calls asking for advice as to how the life of tubes can be prolonged, in view of the shortage of strategic materials. We are glad to cooperate. Results obtained from these studies are mutually beneficial. In order to give an intelligent report as to the probable expectancy of the life of condenser tubes, we ask that two or three tubes be taken out of the condenser and sent to us. We do not mean little pieces but full lengths. The inlet and outlet ends as well as the top or bottom of each tube should be carefully marked for future identification. Our Laboratory can then study the whole tube from end to end and make its recommendations.

As you are no doubt aware, in many cases corrosion is localized to a certain portion or portions of the tube. Changing the operation of the condenser or protecting the corroded section of the tube may prolong its life appreciably. Data regarding the date when the tubes were installed; operating conditions, including temperature; circulating water speed; nature of the water; kind of alloy and other facts; are all necessary in helping to diagnose the seriousness of the corrosive attack.

The Laboratory is also in a position to suggest superior alloys which can be installed at some future time when restrictions are removed. Oftentimes the engineer can cooperate with the Laboratory by installing several lengths of special alloy tubes in order to obtain a service test under actual operating conditions. Such cooperation will some day bring about greater economy and lower maintenance of condenser tubes.

The marine field at the present time is in a more favorable position than the power plants as far as the selection of condenser tube alloys is concerned. While the land stations are limited to either Muntz or Admiralty, marine power plants are not limited and can use any alloys that are made. In the meantime, our Laboratory is accumulating more and more information on condenser tube alloys and their behavior under various conditions.

Considerable technical information has already been published in our new Condenser Tube Manual, which is available at no cost to engineers who request it. In addition to data on corrosion, we are listing the properties of the alloys which have been developed to give longer life. At the same time, it would be helpful to us if condenser tube users would contact us and tell us their experiences and problems. Requests for our new Condenser Tube Manual have exceeded all expectations. Fortunately we printed a sufficient quantity so that we are able to take care of additional calls. If you do not have a copy, drop us a line.



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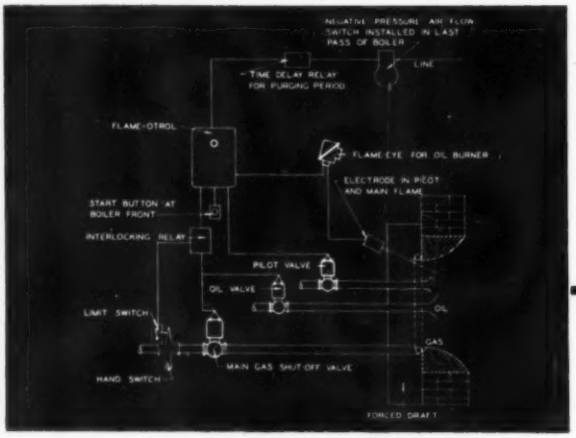

This Electronic Combustion safety device (a Wheelco pioneered electronic achievement) eliminates explosion hazards by preventing fuel and explosive product accumulation in the combustion chamber. Fuel, to the burner, is shut off instantly upon flame failure, or should any condition develop within the instrument itself, which might interfere with its operation. It is also a definite protection against carelessness and negligence of inexperienced operators. The Wheelco Flame-otrol operates with equal efficiency on gas, oil, powdered coal, or any combination of these fuels. Flame-otrols are available with automatic or manual ignition, time delay for purging, or other desirable sequence.

Request Bulletin L2 for complete information on the Wheelco Flame-otrol.

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For complete information on the installation of Walseal valves, fittings and flanges, send for Bulletin No. 84.

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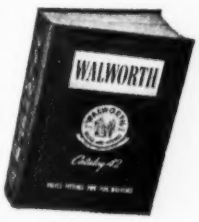

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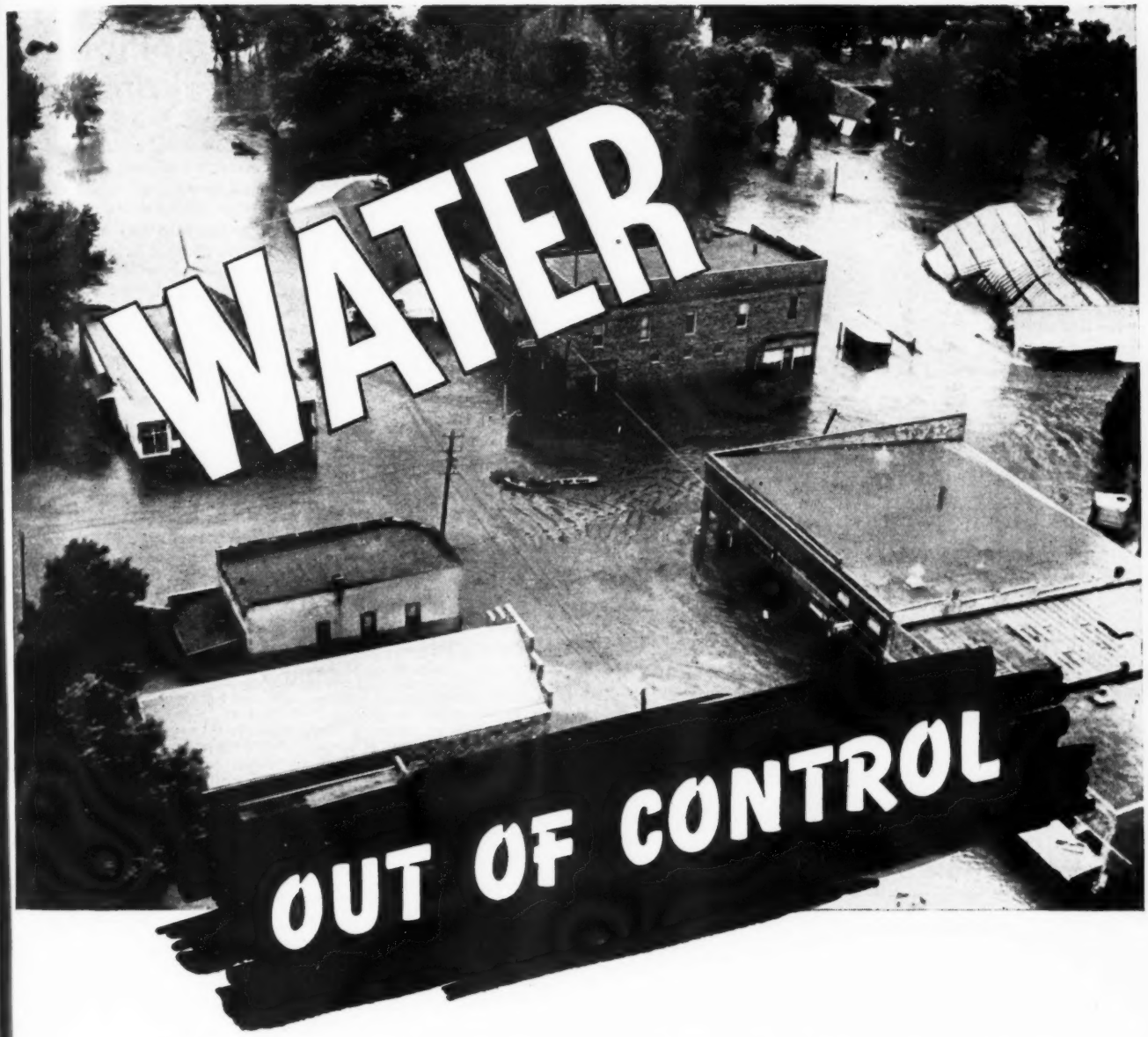

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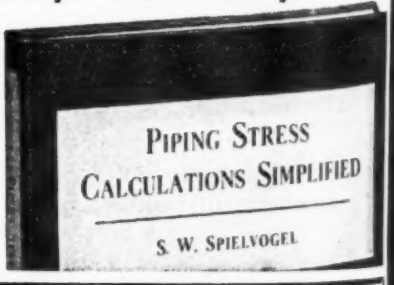

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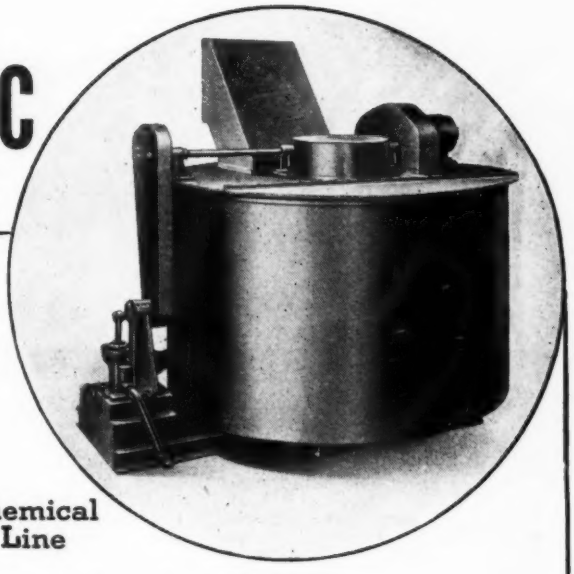

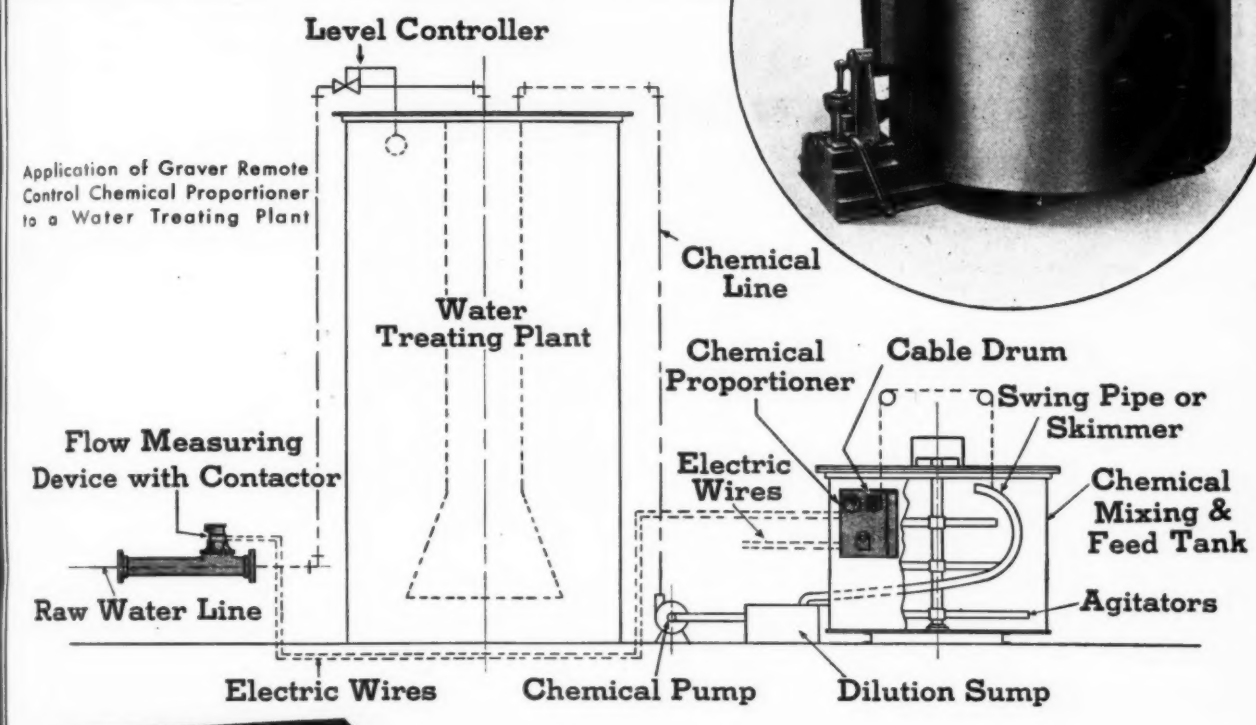

Upper photo shows a Graver Chemical Mixing Tank

Lower photo shows the Graver Remote Control Proportioner

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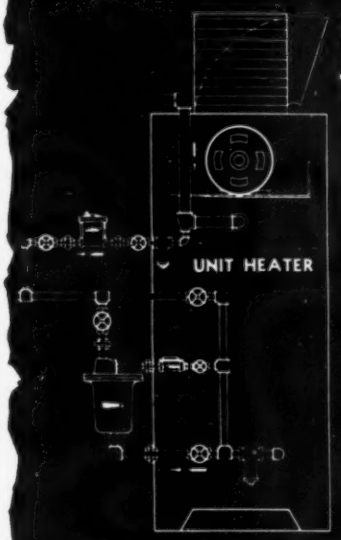
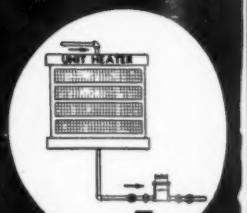


FLOOR-TYPE HEATER with Strong 70 Series trap draining inlet line, and 80 Series with Thermal Air Valve draining heater. Note strainers ahead of traps. OVERHEAD HEATER (circle) drained by Strong 70-T trap, with built-in thermal vent.



Accumulated condensate and trapped air can make unit heaters slow in starting. Uncertain drainage can seriously reduce heat output.

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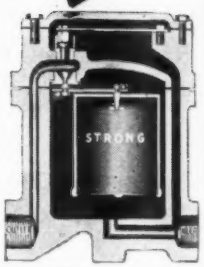
While all Strong Inverted Bucket Traps will handle large amounts of air, the hookups shown here provide thermal air vents for practically instantaneous heating. Use of Strong anti-balancing traps, guaranteed for a year against leakage, insures positive drainage without waste of steam.



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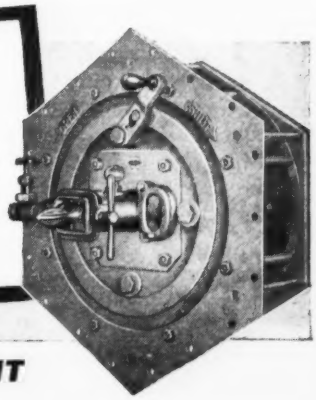

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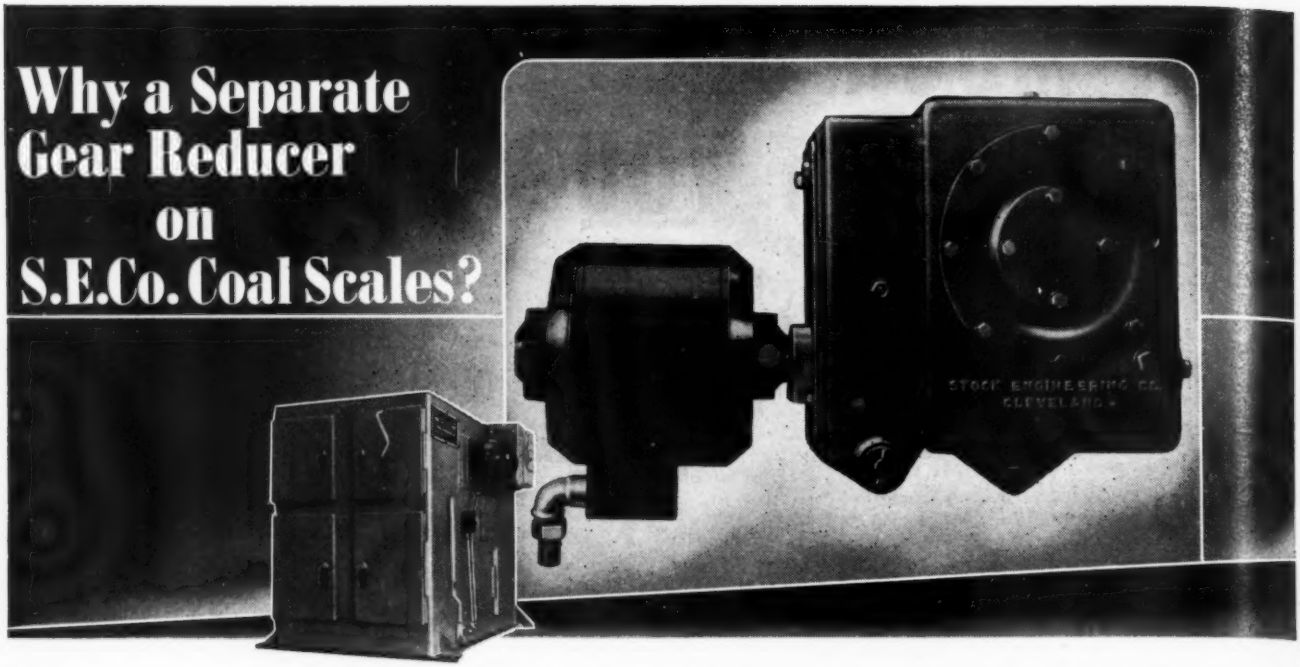

• The Gear Box on S.E.Co. Coal Scales is designed to double horsepower rating of the motor thus insuring absolute freedom from gear troubles. Momentary overloads do not cause injury to the gears . . . rugged construction eliminates maintenance. All S.E.Co. Coal Scales are equipped with a standard, totally enclosed ball bearing motor. Because this type of motor is usually available from many different manufacturers' stocks, the necessity of S.E.Co. Coal Scale users maintaining spare motors in stock against possible electrical troubles is eliminqted. A Shoe brake gives quick stop of scale feeder . . . assures accurate weighing because of its liberal size. Get further details on the S.E.Co. Coal Scale! Write to Stock Enginering Company, 9807 Theodore Avenue, Cleveland, Ohio.

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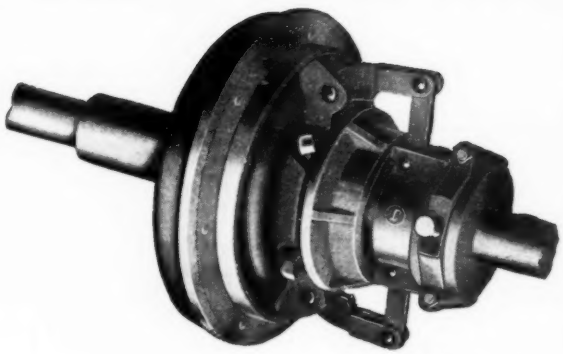

JONES-LEMLEY friction clutches are built for a broad range of shaft sizes and ratings in both enclosed and open types for sleeve and coupling work. In addition they are available in a line of Jones-Lemley friction clutch pulleys. This clutch modification is also used for gears, V-belt sheaves, sprocket wheels, etc. Sizes, ratings, dimensions, prices and other data are contained in Bulletin No. 60. Your request will bring a copy.

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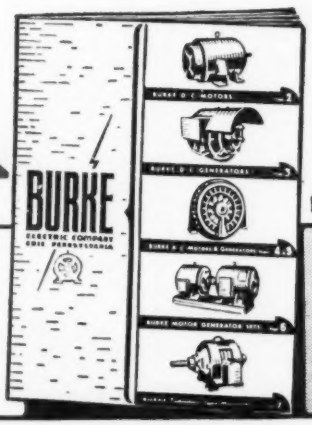

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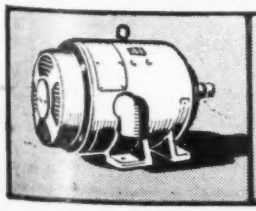

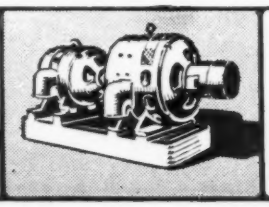

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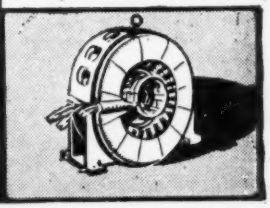

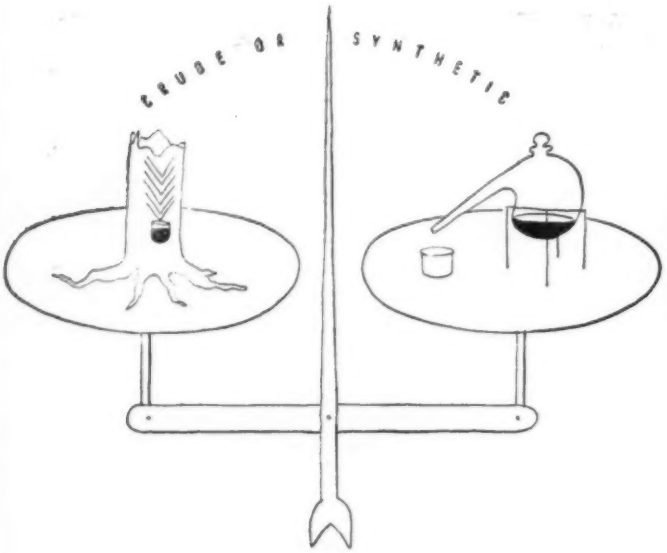

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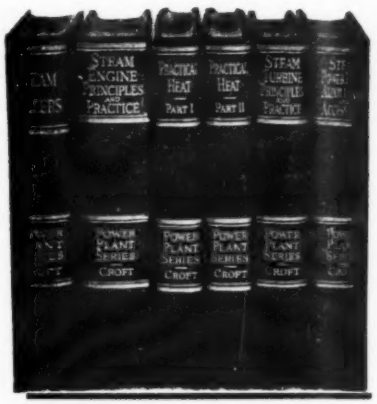

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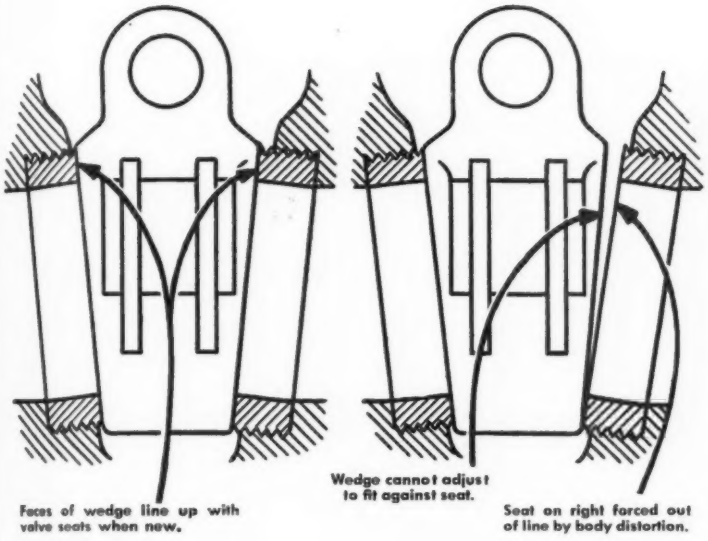
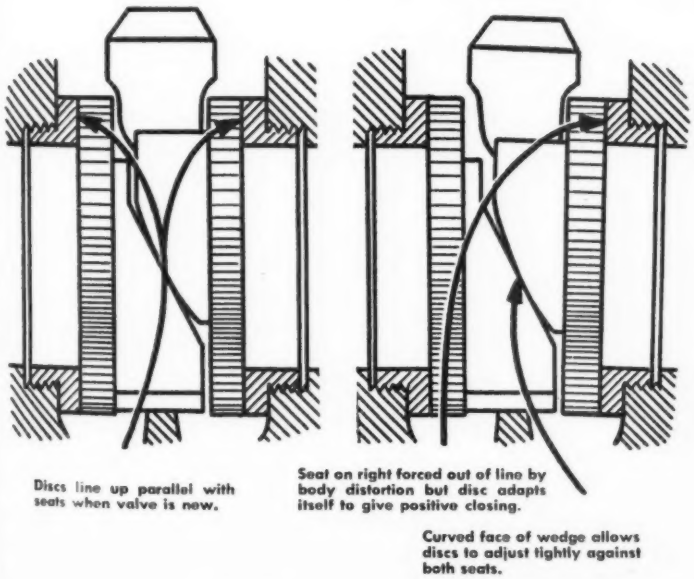

Faces of wedge line up with valve seats when new.
Wedge cannot adjust to fit against seat.
Seat on right forced out of line by body distortion.

ABOVE—What happens before and after a taper seat gate valve is subjected to body distortion is shown in these somewhat exaggerated diagrams.

BEFORE AND AFTER

BELOW—How the Darling Fully Revolving Double Disc Parallel Seat gate valve continues to give positive closing despite body distortion.


Discs line up parallel with seats when valve is new.
Seat on right forced out of line by body distortion but disc adapts itself to give positive closing.
Curved face of wedge allows discs to adjust tightly against both seats.

ANY valve is tight on the drawing board, or on the assembly floor, but frequently a valve is installed with a pipe out of line, so that the valve body is subjected to unexpected "line strains."

Or expansion bends are not properly installed, so that the valve has to take the punishment of expanding and contracting lines.

The distortion of valve bodies is a continuous and almost microscopic process, but is one of the chief causes of leaking valves. Under the body blows of high temperature and pressure the valve bodies will change shape and valve seats will move out of their original line-up, preventing tight closing.

Over forty years ago Darling Valve & Manufacturing Company designed a valve that could take these body blows and still give positive closure. In the Darling Fully Revolving Double Disc Parallel Seat valve, there are two important features:

1. The floating discs are free to adapt themselves to change in the shape of the valve body, and to changed position of the valve seats.
2. The discs are fully revolving, seating in a different position each time, thus wearing evenly and always presenting a uniform surface against the valve seat. Even when worn thin the discs still furnish a positive seal.

Darling is the only valve which has this simple and efficient design. For "positive closing, year after year," thousands of experienced valve buyers specify Darling for all their tough jobs.

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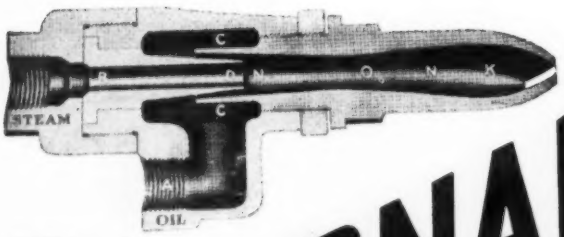

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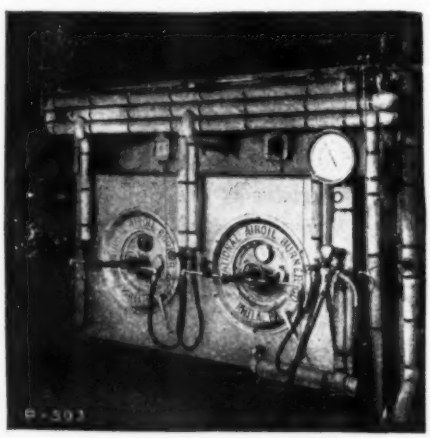

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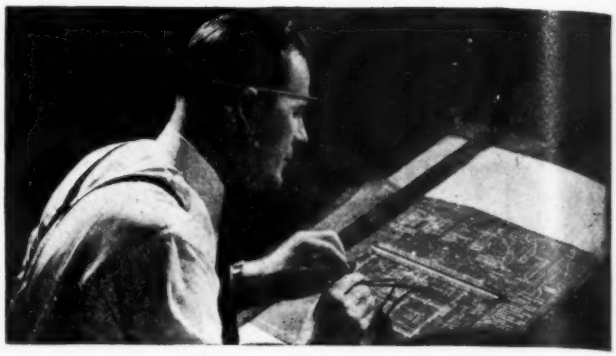

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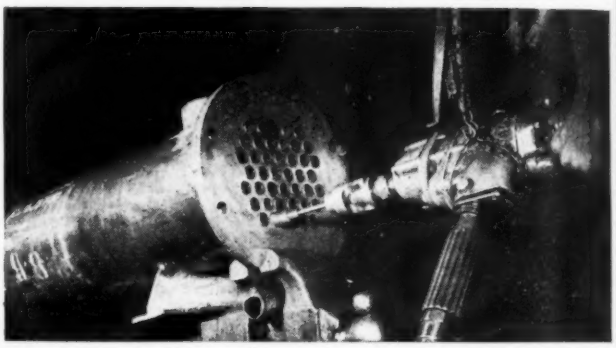

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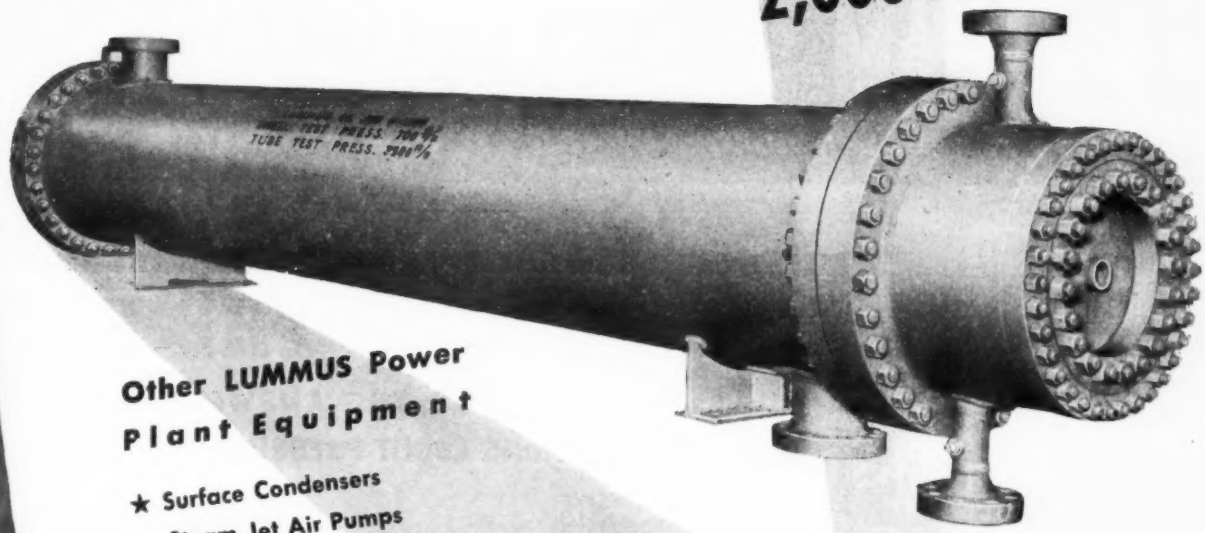

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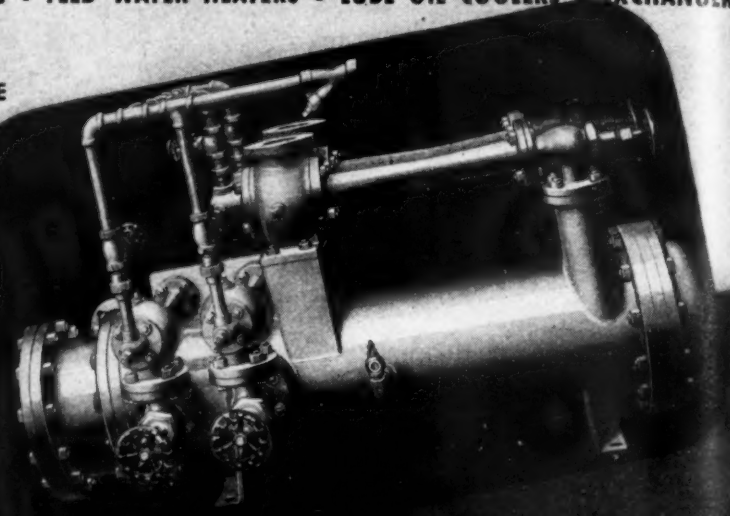

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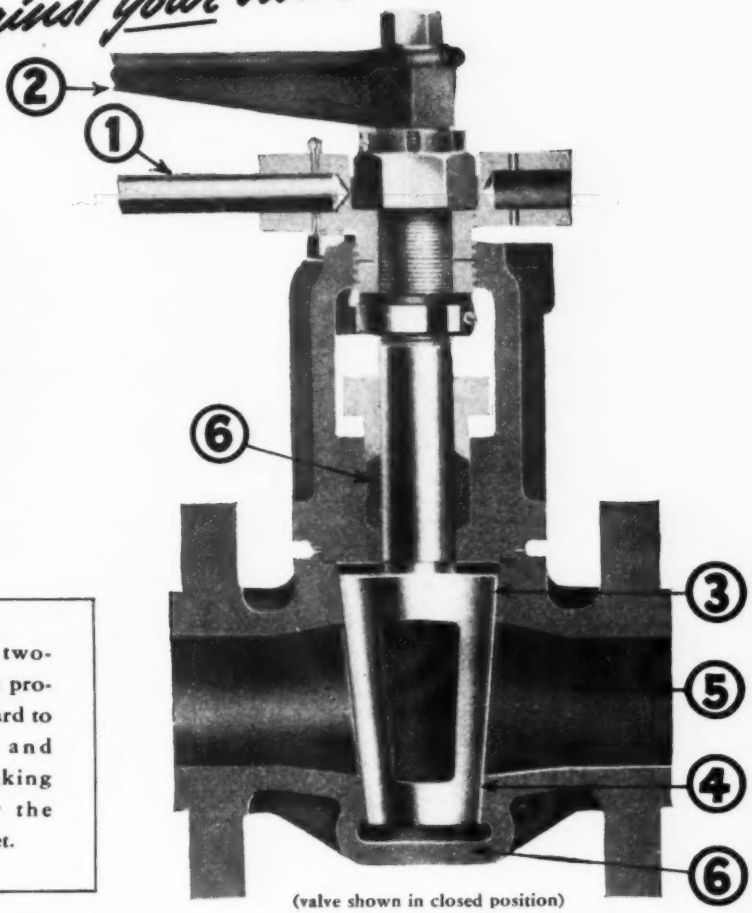

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1. Instant stick-proof operation. — Built into this valve is a powerful lever and screw which relieves seating pressure between plug and body just enough to overcome friction and permit easy turning under any condition.

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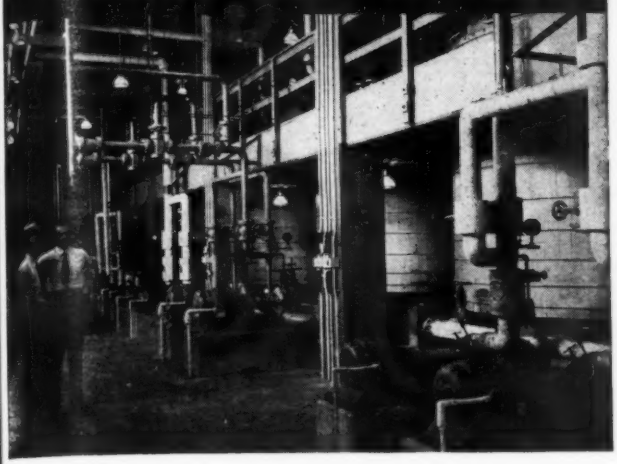

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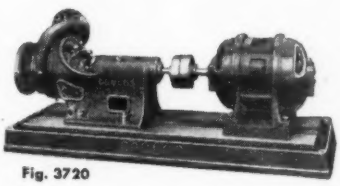

Fig. 3720

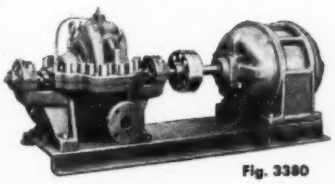

Fig. 3380

Typical Goulds Pumps used in the manufacture of Synthetic Rubber.

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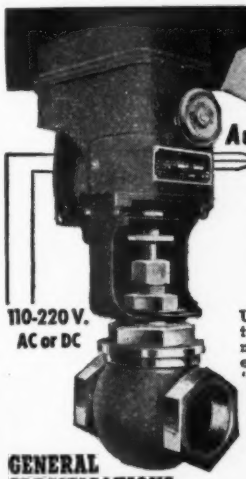

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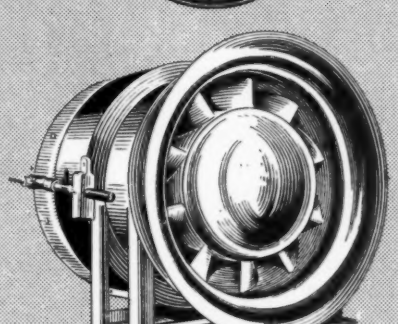

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(Continued on page 330)

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(Continued from page 329)

POWER SUPERVISOR, thoroughly experienced in modern high pressure Power Plants and organizing and handling of personnel. Partial technical education, eighteen years experience. Prefer Southern connection. PW-659, Power, 330 W. 42nd St., New York 18, N. Y.

MAINTENANCE MACHINIST, 42, long experience wishes position in Machine Shop, Power Plant. State particulars and salary. PW-661, Power, 330 W. 42nd St., New York 18, N. Y.

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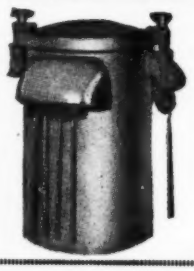
TRANSFORMERS



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6000 KVA WESTINGHOUSE 250-400 lbs. 2300 volts, with surface condenser.

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3 Phase, 60 Cycle

1000 KW GENERAL ELECTRIC 3-UNIT synchronous 125/250 volts D.C., 4000/2300 volts A.C., 720 RPM.

500 KW GENERAL ELECTRIC synchronous 700 volts D.C., 4150 volts A.C., 720 RPM (Full Automatic).

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3 Phase, 60 Cycle

3500 KW (2) WESTINGHOUSE 225-285 volts D.C., 225 RPM, with 13200 volt transformers.

750 KW GENERAL ELECTRIC 600 volts D.C., 1200 RPM, with 2300/4000 volt transformers.

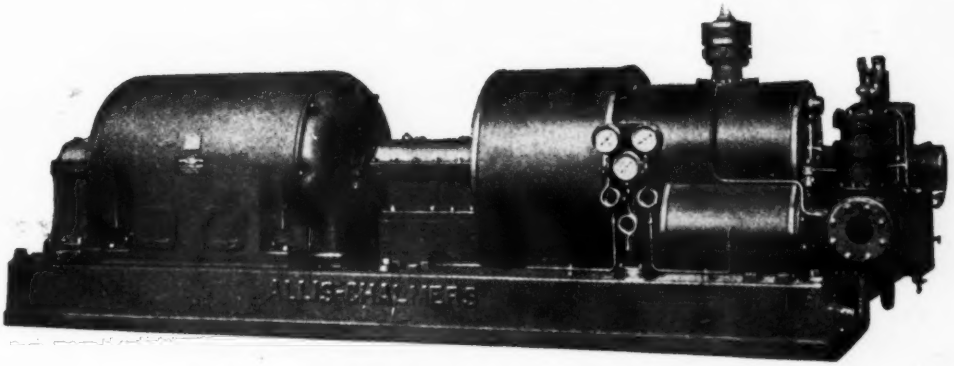
ENGINE GENERATORS

3 Phase, 60 Cycle

438 KVA GENERAL ELECTRIC-SKINNER uniflow, 150 lbs. 5 lbs. back pressure, 240/480/2300 volts.

340 KVA WESTINGHOUSE SKINNER uniflow, 150 lbs., 5 lbs. back pressure, 240/480/2300 volts, 200 RPM.

210 KVA GENERAL ELECTRIC engine type generator, 2300 volts, 225 RPM.



1250 KVA ALLIS CHALMERS CONDENSING TURBO UNIT

1250 KVA Allis Chalmers alternating current generator 3 phase 60 cycle 2300 volts 3600 RPM direct connected to Allis Chalmers condensing turbine 150-200 lbs. steam pressure 100 deg. superheat. Equipped with jet condenser and auxiliaries.

1000 KW GENERAL ELECTRIC MOTOR GENERATOR SET

Actual Photograph

1000 KW GENERAL ELECTRIC direct current generator 125/250 volts 3-wire 720 RPM direct connected to 1400 HP 80% P.F. GENERAL ELECTRIC synchronous motor 3 phase 60 cycle 13200/6600 volts 720 RPM.

DIESEL GENERATORS

3 Phase, 60 Cycle

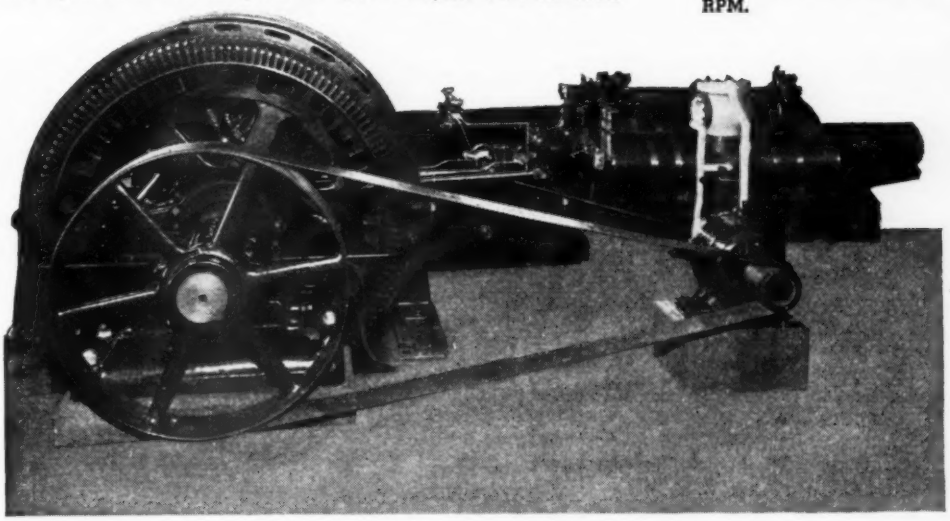
225 KVA WESTINGHOUSE-WORTHINGTON 2300 volts, 275 RPM.

850 KVA (3) WESTINGHOUSE-NORDBERG 2300 volts, 180 RPM.

DIESEL ENGINES

240 HP FAIRBANKS MORSE 6 cylinder model 35-E, 400 RPM.

300 HP FAIRBANKS MORSE 4 cylinder model 32-E, 300 RPM.

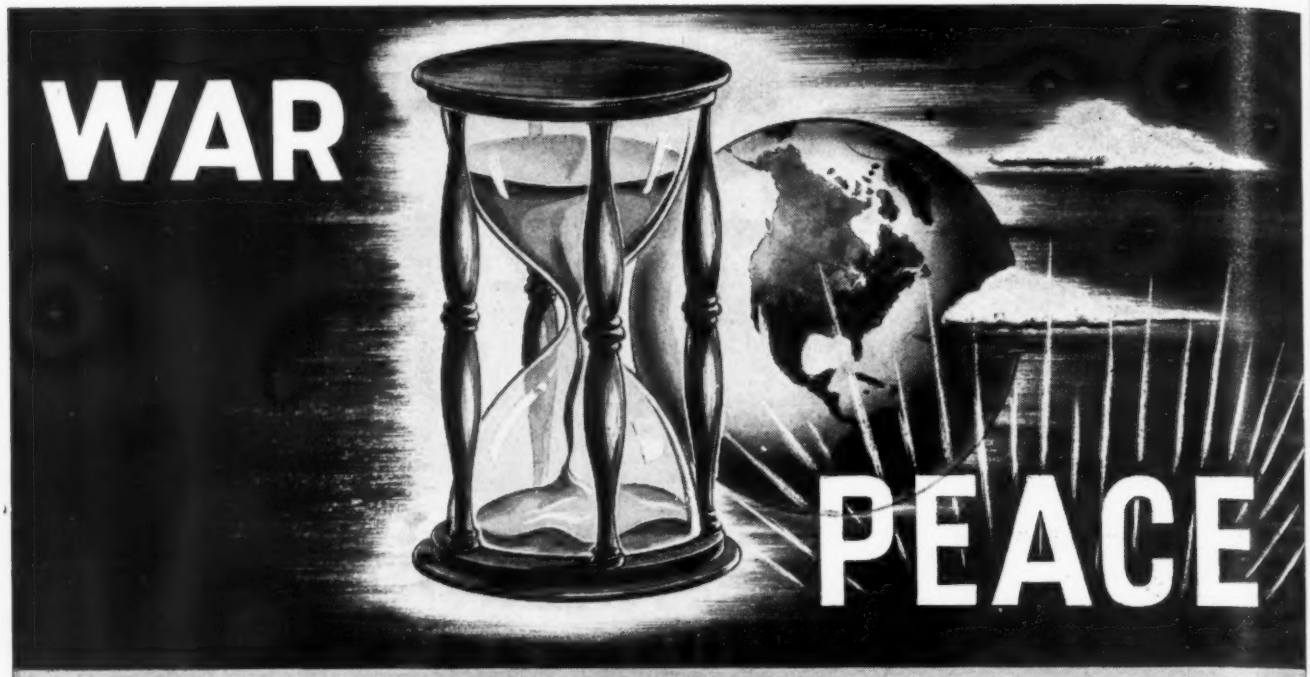


Actual Photograph

675 KVA SKINNER UNIFLOW UNIT

675 KVA Electric Machinery alternating current generator 3 phase 60 cycle 2300/600/480 volts direct connected to Skinner Universal uniflow engine, 150-175# steam pressure, 0-10# back pressure, 150 RPM.

THE NATIONAL POWER MACHINERY CO.
1921 SCRANTON ROAD CLEVELAND, OHIO



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TURBO GENERATOR SETS
CONDENSING A. C.

1—15300 KVA Westinghouse 3/60/13800/1800 RPM
1—6250 KVA Gen. Elec. 3/60/2300/3600 RPM
2—6250 KVA Westinghouse 3/60/2300/3600 RPM
1—6000 KVA Westinghouse 3/60/2300/3600 RPM
1—4000 KVA Allis Chalmers 3/60/2300/3600 RPM
1—4000 KVA Westinghouse 2/60/2400/3600 RPM
1—3750 KVA Gen. Elec. 3/60/2300/3600 RPM
2—3125 KVA Gen. Elec. 3/60/2300/4000/3600 RPM
1—2500 KVA Westinghouse 3/60/2300/3600 RPM
1—1560 KVA Westinghouse Extraction 150 lb. 12 lb. 3/60/480/3600 RPM
1—937 KVA Gen. Elec. 3/60/480/3600 RPM
3—625 KVA Gen. Elec. 3/60/220/3600 RPM Extraction
1—250 KVA Allis Chalmers Extraction 3/60/480 volt

NON-CONDENSING A. C.

6000 KVA West. 3/60/2300/3600 RPM
2500 KVA West. 3/60/2300/3600 RPM
500 KVA West. 3/60/480/900/6000 RPM
470 KVA West. 3/60/480/3600 RPM
375 KVA West. 3/60/2300/900/6000 RPM
250 KVA Gen. Elec. 3/60/480/3600 RPM
156 KVA West. 3/60/240/3600 RPM
75 KVA Allis Chalmers 3/60/240/3600 RPM

A. S. M. E. BOILERS

2—750 H.P. Edgemoor 200 lb.
4—500 H.P. Vogt, stokers, 175 lb.
1—500 H.P. Keeler, stoker 160 lb.
1—400 H.P. B. & W. 200 lb.
1—250 H.P. Titusville self cont. 100 lb.
1—200 H.P. Keeler C.P.—stoker new 1942
1—125 H.P. Keeler—stoker 160 lb.

MOTOR GENERATOR SETS

3—250 K.W. G.E.—MPC—250 V. 1200 RPM Syn.
1—200 K.W. Crocker Wheeler 250 V. 3/60/2300/900 Syn.
1—125 K.W. G.E. 250 V. 3/60/2300/900 Syn.
1—100 K.W. West. 125 V. 3/60/200 Sq. Cg.
2—50 K.W. G.E. 125 V. 3/60/220/1200 RPM
1—40 K.W. West. 125 V. 3/60/220/1200 Syn.
1—20 K.W. Crocker Wheeler 250 V. 3/60/220/900 RPM

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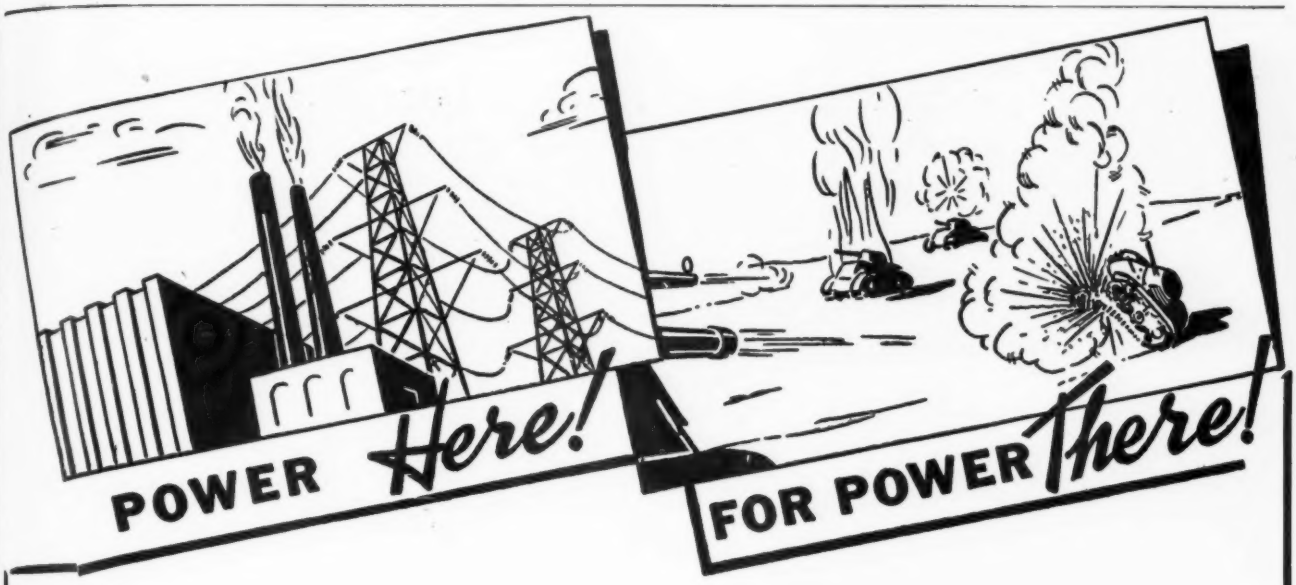

MOTORS GENERATOR SETS

1—2000 ampere, 6 volt, Hanson-Van Winkle
1—1500 ampere, 6 volt, Hanson-Van Winkle
1—750 KW, 250 volt, Allis Chalmers synchronous
1—75 KW, 125 volt, General Electric, squirrel cage.
1—20 KW, 600 volt, General Electric squirrel cage induction motor.
1—6½ KW, 125 volt, General Electric, squirrel cage

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis Chal.

MOTORS—3 PHASE 60 CYCLE

1—500 HP, 900 RPM Lincoln, 440 volt, slip ring
1—400 HP, 514 RPM, 440 volt, Westg., slip ring.
1—350 HP, 300 RPM, 440 volt General Electric slip ring
1—335 HP, 600 RPM, 2300 volt, G.E., syn.
1—300 HP, 720 RPM, 2200 volt, G.E., slip ring.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—250 HP, 600 RPM, 4000 volt, G.E., Sync.
1—200 HP, 600 RPM, 2200 volt, G.E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—150 HP, 1800 RPM, 440 volts, General Electric, squirrel cage.
1—150 HP, 1750 RPM Westinghouse, slip rg.
1—150 HP, 1200 RPM, General Electric, squirrel cage.
1—150 HP, 900 RPM., 440 volt, Al. Ch. sl. rg.
1—100 HP, 900 RPM, 440 volt, G.E., sl. rg.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—125 HP, 720 RPM Allis Chalmers, slip rg.
1—100 HP, 720 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.

INSTRUMENTS

25—Westinghouse type U Recording Ammeters with slit core, CT.

25—Westinghouse type U Recording Volt-meters.

MOTORS—3 PHASE 60 CYCLE (Con't)

2—100 HP, 450 RPM, 440 volt, G.E., sq. cg.
1—90 HP, 400 RPM, 550 volt, Cr. Whlr., sq. cg.
1—75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
*—75 HP, 900 RPM, 220 volt, Fairbanks Morse, slip ring.
1—75 HP, 900 RPM, 440 volt, G.E., sq. cg.
1—75 HP, 720 RPM, 440 volt, Westghse., slip ring.
1—75 HP, 720 RPM, 440 volt, G.E., sq. cg.
2—75 HP, 1200 RPM, 2200 volt, G.E., Vertical.
1—50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1—50 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D.C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL, Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
2—150 HP, Westghse., 550 RPM, Type SK.
1—150 HP, 750 RPM, Electro Dynamic.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1—80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1—75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.
1—65 HP, 1000 RPM, G.E., Type RC.
8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—65 HP, G.E., 625 RPM, Type DLC-65, Form A.
1—50 HP, 750 RPM, Westghse., Type SK.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—40 HP, G.E.-Sprague, 700 RPM, Type LC.
1—40 HP, 775 RPM, Westinghouse.
1—40 HP, 800 RPM, G.E.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—35 HP, G.E., 650 RPM, Type RC-15.
1—30 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-13, Form A.
2—20 HP, Westghse., 1700 RPM, Type SK.
1—15 HP, G.E., 800 RPM, Type RC-11.

TRANSFORMERS

2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—200 KVA, G.E., 2200/220/440.
3—150 KVA, G.E., 33,000/ 2300/4000 Y.
3—100 KVA, Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200-250 volts.
3—75 KVA, G.E., 13,500-750/440 volts.
3—75 KVA General Electric, 2200/220/110
1—75 KVA, G.E., 3 phase, 4156Y—120/208Y.
3—50 KVA, G.E., 2200/220/110.
2—50 KVA, Pbgh. 7500/15000 volts-110/220 volts.
3—37½ KVA, G.E., 2200/220/440.
2—30 KVA Allis Chalmers, 3 phase, 4156Y/120/208Y
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.

MOTORS—VARIABLE SPEED 230 VOLTS

2—100 HP, 475/1375 RPM, Electro Dynamic.
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—35 HP, 500/1500 RPM, Westinghouse.
1—35 HP, 350/1050 RPM, Electro Dynamic.
1—30 HP, 225/900 RPM, Crocker Wheeler.
7—25 HP, Westinghouse, 650/2200 RPM, Type SK-110L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

TURBO-GENERATORS

600 KW Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 430 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v., cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 v., cond.

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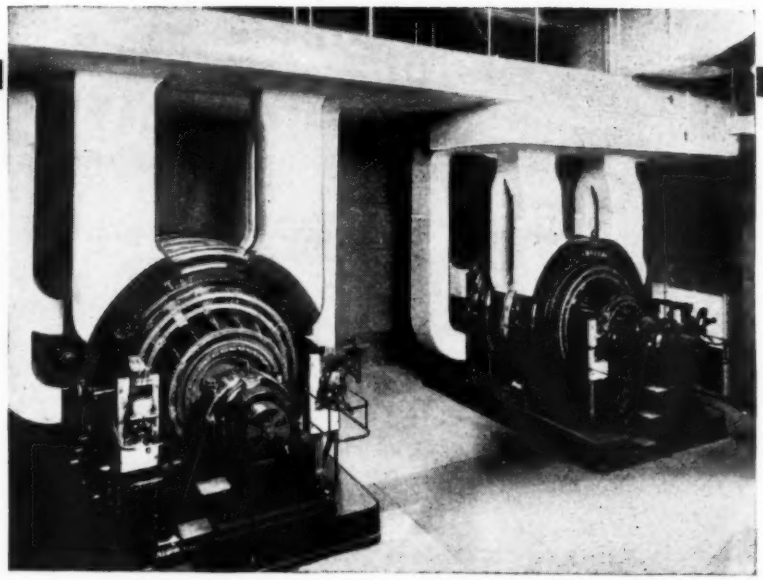
1 These sets as illustrated at right consist of 1500 KW Westinghouse, 250 volts, 360 RPM, d. c. generators, with commutating interfield poles, direct-connected on sub-base to 2250 KVA Westinghouse synchronous motors, 3 phase, 60 cycle, 12000/2300 volts, 360 RPM.



The 2—1500 KW units, as shown above, can be seen running, and can be furnished completely as shown. Write for complete information.

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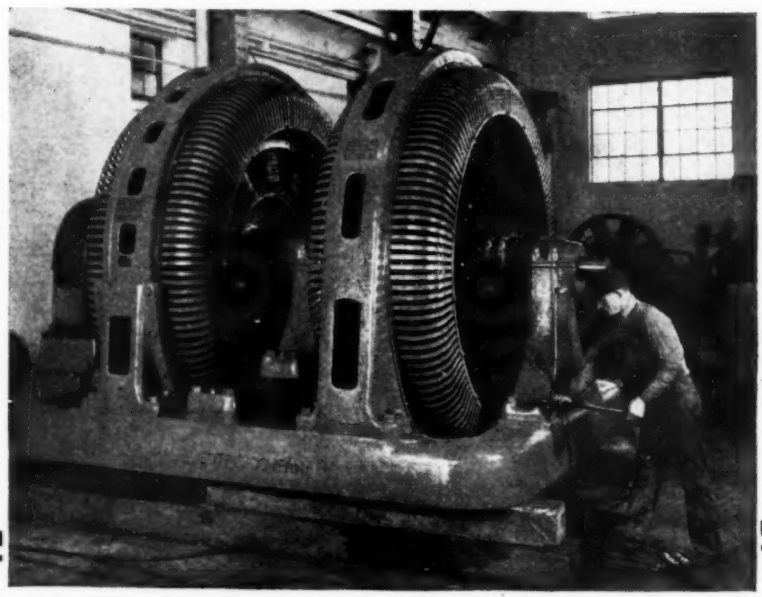
2 1—1400 HP General Electric type ATI-24-1250M-300, form C, 3 ph, 60 cy, 460 volt, 300 RPM, 1570 amps, 1250 KVA, 0.9 P.F. 50° synchronous motor with amort. wdg.; dir/conn. to 1000 KW General Electric type ATI-10-1250M-300, 3 ph, 25 cy, 460 volts, 300 RPM, 1570 amps, 1250 KVA, 0.8 P.F. 50° A.C. generator with amort. wdg., with 33 KW G.E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)

1400 H.P. General Electric unit illustrated below is completely rebuilt and ready for service. . . . For additional information WRITE, PHONE OR WIRE TODAY.



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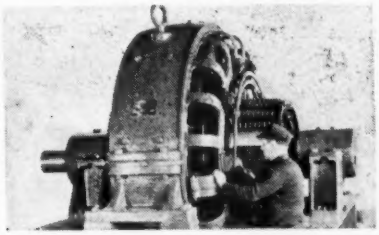

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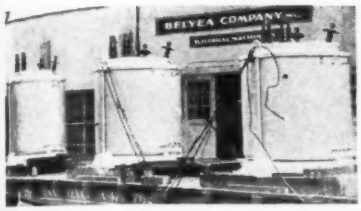

MOTOR GENERATOR SETS
3 Phase 60 Cycle

1—1500 KW G.E., 275 V. D.C. to 2100 H.P., 2300 V.

1—1000 KW G.E., 275 V. D.C. to 1400 H.P., 4150/2300 V.

1—1000 KW WHSE., 600 V. D.C. to 1400 H.P. 4000 V.

1—500 KW G.E., 600 V. D.C. to 700 H.P. 13200/6600 V.

1—500 KW G.E., 250 V. D.C. to 1000 KVA. 2200 V. Syn. Motor.

1—400 KW G.E., 250/275 V., D.C. to 600 HP. 2300 V.

1—300 KW G.E., 250/275 V. D.C. to 400 KVA 440 V.

1—115 KW G.E., 250 V. D.C. to 175 H.P., 440 V. Ind. Motor.

1—100 KW WHSE., 250 V. D.C. to 159 KVA, 2300 V.

1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg. 2300/4000 V.

1—50 KW G. E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.

1—40 KW WHSE., 230 V. D.C. to 45 KVA 2300 V.

1—35 KW A. B. See 230 volt D.C. to 50 H.P. 220 volt sq. cg. motor with exciter.

TURBO GENERATOR SETS

1—500 KW Whse. 625 Kva. 440 V. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.

1—75 KW Ridgeway 250 V. D.C. with Terry turbine 180 lb. pressure with 12 lb. bk. pres., 2000 RPM.

A. C. GENERATORS AND SYNO. MOTORS
3 Phase—60 Cycle

HP or KVA	Make	Type	Volts	Speed
2—2100	G.E.	ATI	2300	514
1—1000	Whse.		2300	900
1— 750	G.E.	ATI	220/440	900
1— 600	G.E.	ATI	220/440	900
1— 625	Whse.		480	900
1— 500	G.E.	TS	440	360
1— 225	G.E.	ATB	220	600
1— 159	Whse.		2400	900
1— 150	Whse.		4000	1800
1— 100	Whse.		2400	900
2— 100	Whse.		2300	1800

A. C. MOTORS
3 Phase—60 Cycle
SLIP RING

HP	Make	Type	Volts	Speed
1—1200	Cr. Wh.	801Q	2300	237
1— 800	Al. Ch.	ANY	440	885
1— 800	Whse.	CW	440	357
2— 600	G.E.	IP	440/2200	720
1— 450	Whse.	HW	2200	875
1— 400	Al. Ch.	ANY	440	1200
1— 400	Al. Ch.	ANY	2300	505
1— 400	G.E.	IP	440/2200	600
1— 350	G.E.	MT-442	2300/4000	257
1— 300	G.E.	IM	440	720
1— 300	Whse.	CW	440	585
1— 250	G.E.	I-17B	440	450
1— 250	G.E.	MT	4000/2300	257
1— 200	G.E.	IF-M	2200	1750
1— 200	Whse.	CW	2200	514
1— 200	G.E.	I-M	440	600
1— 150	G.E.	IM	2200	695
1— 150	G.E.	MT-564	440	600
1— 150	G.E.	IM-17B	2200	290
1— 100	G.E.	IM	220	1750
1— 100	G.E.	MTC-5546	220/440	860

A. C. MOTORS
SQUIRREL CAGE

HP	Make	Type	Volts	Speed
1—500	G.E.	I-17B	2200	690
1—400	Whse.	CS-1104A	2200	585
1—300	Whse.	CS	550	580
1—300	G.E.	IK	440/2300	600
1—200	G.E.	IK	2300	490
4—175	G.E.	IK	440	900
1—150	Lincoln		440	1200
1—150	G.E.	IE	440	1200
1—150	Al. Ch.	AN	440	1765
1—100	Whse.	CS	550	1750

GEAR REDUCTION UNITS

1—2100 H. P. Whse. 1800/360 RPM.
1— 943 H.P. G.E. 5306/1200 RPM
1— 450 H.P. G.E. 3600/1200 RPM

THE BELYEA REPUTATION PROTECTS YOU!

ROTARY CONVERTERS
3 Phase, 60 Cycle

Qu.	KW	Make	Speed	DC V.	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	G.E.	900	600	13200
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
3	300	G.E.	1200	600	2300

3 Phase, 25 Cycle Booster Type

2	1500	G.E.	500	225/275 13200/6600
1	500	G.E.	750	225/275 13200/6600

All units can be furnished with AC and DC controls

TRANSFORMERS
60 Cycle

KVA	Make	Ph.	Type	Voltages
6—1667	Pitts	1	OISC	13200x2300
4— 525	G.E.	1	HJ-DD	2300x445
3— 333	Maloney	1	OISC	22000/11000x2300/575
2— 333	Whse.	1	OISC	2300x460
2— 333	Pitts.	1	OISC	2400x220
3— 300	G.E.	1	H	13200x2300/575
2— 200	G.E.	1	HILD	26400x115/460
3— 200	G.E.	1	H-KDD	13800x220/440
3— 150	Whse.	1	SK	2200x440/220
3— 150	Whse.	1	SKM	2400x120/240
6— 100	Whse.	1	SK	6900x460/230
3— 100	Whse.	1	OISC	13200x250

D. C. MOTORS

HP	Make	Type	Volts	Speed
2—1250	G.E.	MPC	500	130
1— 800	G.E.	MPC	550	600
2— 625	G.E.	MPC	250	130
2— 600	G.E.	MPC	550	600/800
1— 500	G.E.	MPC	230	900
1— 350	G.E.	MPC	230	450
2— 300	G.E.	DMC	230	400/600
2— 300	Whse.		500	250/400
1— 300	G.E.	MPC	230	275/550
1— 300	G.E.	MPC	230	250/440
1— 250	Al. Ch.	Irt	230	525
2— 200	Whse.		230	400/500
1— 175	Whse	SK	250	150/525
1— 150	G.E.	RC-19	230	800/1000
1— 150	Whse.	SK	230	300/900
2— 125	G.E.	CO-1832	230	625
2— 120	Whse.	SK	230	720
1— 100	Al. Ch.		230	950/1150
3— 100	G.E.	LC	230	1200
1— 100	G.E.	MPC	230	225/450
1— 100	Whse.	SK	230	600
2— 100	G.E.	RC-19	230	575/720
1— 75	G.E.	C	230	500/1000
3— 70	Whse.	SK-183	230	560/780
1— 60	Al. Ch.	E-146	115	1150
1— 60	Al. Ch.	E-131	115	1750
1— 60	Diehl	K-11	230	500/1000
2— 60	Cr. Wh.	CMC-65H	230	500/1000
1— 50	Cr. Wh.	CMC-81H	230	300/900
1— 50	Cr. Wh.	CMC-80H	230	380/750
10— 50	G.E.	RF-16	230	400/1600

RE-NU-BILT BELYEA MOTORS

SUCCESSFUL OPERATION GUARANTEED

BELYEA
COMPANY INC.

Main Office & Shop: 43 HOWELL ST., JERSEY CITY, N. J.

KIEMLE OF TOLEDO, OHIO

MOTORS
GENERATORS
CONTROLS
TRANSFORMERS
MOTOR GENERATOR SETS
ETC.

BERGER OF ROCHESTER, N.Y.

Put all idle equipment to work. Send your list for prompt action.

TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300, 1 phase 25 cycle.
1—200 KVA Maloney type H.E. 2400/120/240 volts, 1 phase 60 cycle.
1—200 KVA, G.E., type H.K. 2300/115/230 volts, 1 PH. 60 cy.
2—250 KVA Pittsburgh, 2300/115/230 volts, 1 PH. 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.
OTHER SIZES, VOLTAGES AND CYCLES AVAILABLE

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle 3 phase, 450 rpm with direct connected exciter.
200 KW Westh. Unity Power Factor, 3 PH. 60 cyc. 900 R.P.M. with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 RPM, revolving field, built-in exciter.
150 K.W. Elect. Mach. Revolving fields, 3 Ph. 25 cy. 440 volts 750 R.P.M.

D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115/230 V, 600 RPM.

MOTOR GENERATOR SETS

Western Elect. 1000 Amps—40 volts direct con. to either AC or DC 580 RPM Motor.
125 K.W. Crocker Wheeler, 250 Volts D.C. Comp. WD. Dir. Con. To G.E. 2300 or 440 Volts Sq. Cage Motor
100 K.W. Gen. Elect. 3 BRG. 125 Volts D.C. Comp. WD. INT. with 220/440 Volts Sq. Cg. Motor.
100 K.W. Gen. Elect. 3 BRG. 230 Volts D.C. Comp. WD. INT. with 2300 Volts Sq. Cg. Motor.

CRANE MOTORS

75 H.P.—G. E. 51—230 Volts—550 RPM
35 H.P.—G. E. Form D—550 Volts—590 RPM
25 H.P.—Form E—550 Volts—760 RPM

2-Ton Shephard Hoist With 3-H.P. Hoist Motor and 2-H.P. Trolley Motor 3 Phase. Can Be Used Remote Control.

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle, 750 speed, 220/330 volts. With Transformers for 2300 volts.

FREQUENCY CHANGERS

40 KW GE type I.T.T. frame 553 3 ph. 25/62, ½ cy. 220 volts primary 440 volts secondary, 750 RPM direct con. to 40 H.P. GE type KT543— 3 ph. 25 cy. 220 volt, 750 RPM.

OTHERS IN ALL SIZES VOLTAGES AND CYCLES

3 ph. 60 cy. A. C. MOTORS

H.P.	Make	Type		Speed	Volts
250	West	S.C.	C.S.	900	440
200	West	Syn.	.08 P. P.	900	220/440
		WITH DIRECT CON. EXCITER			
200	Wsghse.	Sl. Rg.	CW	600	220/440
200	Gen. Elec.	Sq. Cg.	1 Form K	514	220/440
175	Ideal	Sl. Rg.	AVA	1750	2200
150	Gen. Elec.	Sq. Cg.	I K	600	2300
150	Al Ch	Sq. Cg.		600	440
150	Burke	Sq. Cg.	3 BRG. 2 ph	900	220/440
125	Gen. Elec.	Sl. Rg.	MT. 553	1200	220
125	Gen. Elec.	Sq. Cg.	I K	720	220/440
25	Gen. Elec.	Sq. Cg.	I. K. Vert.	720	220

3 ph. 25 cy. MOTORS

H.P.	Make	Type		Speed	Volts
830	Elect. Mach.	Syn.	Dir. Con. Exc.	500	2300
350	Gen. Elec.	Sl. Rg. 3 Brg.	I	375	440
200	Lincoln	S. R.	I. X. W.	500	440
150	Burke	Syn.	Dir. Con. Exc.	500	440
150	Gen. Elec.	Sl. Rg.	I Form M	500	2200
100	Wagner	Sl. Rg.	BR	750	220/440
100	Gen. Elec.	Sl. Rg.	I Form M	750	220/440
100	Gen. Elec.	Sq. C.	I K	750	220/440
100	Wsghse.	Sq. C.	CS	500	220/440
75	Wsghse.	Sq. C.	CCL	500	220/440
75	Gen. Elec.	Sl. Rg.	I M	750	220/440
75	Wagner	Sq. C.	BM	750	2200
75	Gen. Elec.	Var.	BTA	375/750	440
50	Burke	Syn.	AC 133	750	220
		WITH DIRECT CON. EXCITER			

230V D. C. MOTORS

H.P.	Make	Type	Speed
150	West	SK180L Comp. Wd. Int.	1150
125	G.E.	CL	850
100	Northwestern	K30 Comp. Inter.	1750
85	Gen. Elec.	Vert. Comp. Wound	700
75	Crocker Wh.	CCM25JA	1700
67	Otis	Elevator Motor Comp. wd.	1200
60	Sprague	D—Comp. Wound	625
50	Gen. Elec.	C. L. 6 Shunt Wound	560
40	Fair. Morse	Ball BRG. Vert. Comp.	1740
32	Sturdevant	C Form P. Shunt Wound	190

Only partial listing

OVER 10,000 ITEMS IN STOCK FOR IMMEDIATE DELIVERY FROM EITHER ROCHESTER, N. Y. OR TOLEDO, OHIO
REBUILT AND SOLD WITH A STANDARD NEW GUARANTEE.

Write or wire your inquiries

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KIEMLE CO.
33 N. SUPERIOR ST.
TOLEDO OHIO

REBUILT POWER EQUIPMENT

READY TO SHIP!

AIR COMPRESSORS

1—599 CFM Ing. Rand Imperial 10, XB-2 horiz. 2 st. duplex, 100 lbs. pres. with A.C. mtr.
1—725 CFM Nat'l Brake, type 3VD, 100 lbs. pres., single stage, complete with A.C. mtr.
1—888 CFM Ing. Rand Imperial 10, XB-2 horiz. 2 st. duplex, 100 lbs. pres. with A.C. mtr.

MOTOR GENERATOR SETS

1200 kw. G E. 275 v. 720 rpm., 4100 v., 3 ph. 60 cy. syn.
1000 kw. G.E. 250 v. 720 rpm., 4150 v. 3 ph. 60 cy. syn.
1—150 KW Ridgway 250 v. 900 rpm. 2200 v. 3 ph. 60 cy. syn.
1—150 kw. Crocker Wheeler 250 v. DC, 600 rpm. dir. con. to 220/440 or 2200 v. syn. motor.
150 kw. G.E. consisting of 2—75 kw. 90 v. D.C. 900 rpm., generators dir. con. 225 HP. syn. motor 2300/4100 v. 3 ph. 60 cy. 70% P.F. motor.
125 kw. Cr. Wh. 250 v. D.C. 1200 rpm., 220/440 v. 3 ph. 60 cy. Ind.

100 HP. LIDGERWOOD HOIST

Double drum Speedwell 2500 lb. pull at 450' per min. direct driven by 100 hp. A.C. or D.C. Motor.

A.C. GENERATORS

1—62½ KW Westg. 2300 v. or 220/440 3 ph. 60 cy. 1200 rpm.
1—125 KVA Westg. 2200 v. 3 ph. 60 cy. 327 rpm.
1—150 KVA Wagner 220/440 v. 3 ph. 60 cy. 600 rpm.

DISCONNECT SWITCHES

18—300 amp. SPST 7500 v.
6—300 amp. SPST. 1500 v.

TACHOMETERS

3—Brand New, Model C Hickok Generators, 0/2000 rpm., flexible couplings, Hickok model meters—2000 rpm.

25 CY. MOTORS—220/440 V. A.C.

HP	Make	Type	RPM
52	G.E.	ITC	750
40	Al. Chal.	AN	750
35	G.E.	I-M	500
30	Al. Ch.	AN	750
25	Westg.		750
7½	Westg.		705
3	G.E. (1 ph.)	SCR	1500
1	Westg. (vert.)	CSA	750

SLIPRING MOTORS—3 PH., 60 CY.

HP	Make	Type	Volts	RPM
400	Westg.	CW	220/440	1170
350	Westg.	CW	2200	900
280	Burke	EMV-65	220/440	600
250	Westg.	CW	2200	345
150	G.E.	I-M	220/440	720
150	G.E.	MT	2200	1200
100	G.E.	IM	220/440	900
100	G.E.	IM	2200	450
100	Westg.	CI	220/440	1750
75	Westg.	CW	220/440	690
75	G.E.	I	220/440	900
75	G.E.	ITC	220/440	1800
62	Westg.	CW	220/440	1135
60	Triumph	C-16	220/440	430
52	G.E.	ITC	220/440	900
50	Al. Chal.		220/440	490
50	Westg.	HF	220/440	860
50	G.E.	enc.	220/440	1200
50	Westg.	CW	220/440	1150
50	Chandeysson		220/440	1800
40	G.E.	MT	220/440	720
40	G.E.	MT	220/440	1200
20	Cr. Wh.		220/440	850
15	G.E.	IM	220/440	850

A.C. MOTORS—3 PH., 60 CY.

HP	Make	Volts	RPM	Type
1000	G.E.	2300	509	K
250	G.E.	220	720	IK
209	G.E.	220	514	IK
200	Westg.	220/400	580	CS
200	G.E.	220/440	720	IK
150	Westg.	2200/440/220	327	syn.
150	G.E.	220	450	IK
150	G.E.	440	514	IK
150	G.E.	550	575	IK
150	G.E.	220	575	
150	G.E.	440	600	IK
125	Cr. Wh.	220	720	
125	G.E.	220	400	IK
125	G.E.	440	450	IK
125	G.E.	440	514	IK
125	Al. Ch.	220	800	
100	G.E.	440	400	IK
100	Cr. Wh.	220/400	575	
100	Westg.	220/440	700	CS
100	G.E.	550	900	IK
100	Westg.	220	1750	
75	Cr. Wh.	220	514	
75	Westg.	220	600	CS
75	G.E.	550	720	IK
75	Cr. Wh.	550	900	
75	G.E.	220/440	1150	
75	Westg.	2200/220/440	1200	
75	Al. Ch.	220/440	1800	AN
65	G.E.	220/440	1200	IK
65	Al. Chal.	220/440	1800	AN
75	Louis Allis	220/440	170/1770	
60	Triumph	220/440	430	
60	G.E.	550	600	IK
60	Cr. Wh.	220	670	
60	Westg.	220	720	CS
60	Al. Ch.	440	1200	AN
60	Al. Ch.	220/440	1800	AN
54	Al. Ch.	220/440	900	
50/32	G.E.	220/440	800/640	POS
50/100	West.	220/440	345/700	CS
50	G.E.	220/440	400	IK
50	G.E.	220/440	450	IK
50	Westg.	220/440	514	CS
50	Westg.	220/440	600	
50	Westg.	220/440	690	
50	Westg.	220	720	CS
50	Westg.	220/440	850	
50	Amer. (vert.)	440	900	
50	Reliance	220/440	1200	
50	G.E.	220/440	1200	IK
50	Al. Cha	220/440	1800	AN
40	G.E.	220/440	360	IK
40	Westg. (totally enc.)	220	600	CS
40	Amer. (vert.) (fan cooled, totally enc.)	220/440	685	
40	Amer. (enc. ball bearing)	220/440	685	PK
40	Reliance	220/440	900	
35	Westg.	220/440	514	CS
35	Lincoln	220/440	720	
35	G.E.	220/440	900	
35	G.E.	220/440	1200	IK
35 (new)	Westg.	220/440	1800	CS
30	Amer.	220/440	600	
30	G.E.	220	900	I
30	Triumph	220	1200	
25	Triumph	220	850	
25	Westg.	220/440	1200	CS
1½	Ilg.	220	490	
½	G.E.	220	1200	
½	G.E.	220	900	K

VARIABLE SPEED MOTORS—230 V. D.C.

HP	Make	Type	RP M
250	Cr. Wh.	CMC	200/400
75	Westg.	SK-181	400/800
35	Westg.	SK-140	675/1350
30	G.E.	RLC	450/900
20	Westg.	SK-110L	750/1500
20	Westg.	SK-100L	900/1800
15	Louis Allis		1150/1750
15	Westg.	SK-90	850/1700
10	Westg.	SK-111	300/1200
10	Westg.	SK-70	850/1700
10	G.E.	LC	625/1250
10	Westg.		565/1130
7½	Westg.	SK-111	200/1200
7½	Cr. Wh.		385/1155
5	Reliance	F-21	300/1800
3.75	Westg.	SK-111	300/1200
3¼	Westg.		400/1600
3	Jantz-Llest		650/1950
2½	G.E.	RLC	500/1000

TRANSFORMERS—1 ph. 60 cy.

No.	Kva.	Pri.	Sec.	Make	Ph.
1	250	2300	460	G.E.	
1	100	2200	110/220	G.E.	
3	100	6600	550/440/220	Pgh.	
2	75	2200	200	Burke	3 ph.
2	50	2300	220/440	G.E.	
3	50	11430/6600	550	Al. Ch.	
3	50	6600	575	G.E.	
1	37½	2300	220/440	Wagner	
3	37	4400	185	West. (Rotary)	
1	30	2200	110/220	G.E.	
40	10	2200	110/220	West.	
100	7½	2200	110/220	G.E.	
50	5	2200	110/220	G.E.	
75	5	2200	110/220	West.	

SCALES

9—Howe Scales—3 beams (2 at 200 lb. ea.—1 at 50 lbs.). Platform 14½x22", Approx. capacity 500 lbs.

TROLLEYS

20—½ ton Chisholm Moore No. 120, 4" wheel will fit 4½-6-8-10" I Beam.
4—3 ton Trolleys.

INDUSTRIAL TRUCKS

1—Elwell Parker Tow Tractor 2000 lbs. with batteries.
1—Baker Tow Truck with batteries.

PUMPS

2—6x8 Deming Triplex Pumps, 166 g.p.m., 150 lbs. pressure, 335' head, 20 H.P. A.C. or D.C. Motor.

Large Stock—CIRCUIT BREAKERS—METERS — CURRENT AND POTENTIAL TRANSFORMERS—POTHEADS—RELAYS—METERS — SAFETY SWITCHES — DISCONNECT SWITCHES — U-RE-LITES — PULLEYS — REACTORS.

WRITE, WIRE OR PHONE YOUR ELECTRICAL REQUIREMENTS—SEND FOR STOCK LIST.

LIST YOUR IDLE EQUIPMENT WITH US.

DUQUESNE ELECTRIC & MFG. CO.

PITTSBURGH 6, PA.

1904—40 Years Continuous Service to Industry—1944

NEVER BEFORE—SUCH ITEMS AS THESE

WRITE • PARTIAL LIST ONLY • WIRE

DIRECT CURRENT MOTORS

115 Volts

H.P.	Mfr.	Type	Speed
40	G.E.	RC 32	1150
20	Whse.	SK-120	650
20	L. Allis	WD-20 (Vert.)	1000
15 B. Brg.	Cr. Wh.	CCM	850
10	Whse.	SK-60	1150
10	Whse.	SK	850
7½	G.E.	RC	1750
¾ (6)		BD Vertical	3450

Many other smaller motors, too numerous to list.

DIRECT CURRENT MOTORS

230 Volts

H.P.	Mfgr.	Type	Speed
75 (2)	Reliance	310T	1450
65	Cr. Wh.	CMC 65H	600
61/70 (2)	G.E.	CDM	352/400
50	Cr. Wh.	CMC	700
35	G.E.	RF	500/1500
30	Reliance	131T	1450
30	Imp.		850
30/35	G.E.	CDM	176/200
25	G.E.	DLC	750
25	G.E.	CVC	1200
20	Reliance	92T	1450
20	Whse.	SK-111	720
20	Burke	WA-4	900
20	G.E.	CD-105	600
20	G.E.	CQ	1700
20	Whse.	SK-100L	900
20	Whse.	SK	1700
20	Al. Ch.	E-100	1150
20 (2)	G.E.	RC27B	3450
20	Triumph	24F	1750
20	G.E.	RC-11	1150
20	Elec. Dyn.		850
20	Louis Allis		850/1700
15	West.	SK-601	1700
15	Roth	7-S	1150
15 (2)	G.E.	RC-30	850
15 (10)	Reliance	Ball bearing	850
15	Elec. Dyn.		600
15	Whse.	SK-80	1100
15	G.E.	RC-31	1100
15	Cr. Wh.	CM	1150
15	G.E.	RC-80	850
15	Imp.	HV-1	850
15	Imperial		575
12½	West.	SK	400/1400
10	Whse.	SK-63	1150
10 (3)	G.E.	LC	1000/1500
10	W. Elec.	ER3A	1000
10	G.E.	RC-29	850
10	Cr. Wh.	CM	850
10	Whse.	SK-70	850
10	Whse.	SK-90	600
10	G.E.	RC-49	850
10 (3)	G.E.	CVC-115	700
7½	G.E.	RC	3450
½ (16)	G.E.	BD Vert.	3450

The above listing is a very small part of the items in stock.

DIRECT CURRENT GENERATORS

KW	RPM	Volts	Make
115	600	250	Cr. Wh.
100	1000	125	G.E.
100	900	125	Whse.
75	1750	250	Reliance
65	720	250	Cr. Wh.
30	1750	250	Reliance
25	490	125	G.E.
20	1750	250	Reliance
20	900	125	Whse.
18 (2)	1140	250	Reliance
15	1140	125	G.E.
10	1140	250	G.E.
10	1750	125	Whse.
6	900	125	Whse

Also a large assortment of special voltages. We specialize in building Motor Generator Sets to your specifications.

MOTOR GENERATOR SETS

KW	Make	D.C. Volts	Drive
50	G.E.	125	3/60/2300
25	G.E.	125	3/60/440
35	Burke	125	3/60/220
25	Burke	125	3/60/550
15	G.E.	125	3/60/440
6 (2)	G.E.	75	3/60/220
3	Roth	125	3/60/220
3	Chand.	6-12	3/60/220
2	Cont.	120	3/60/220

D.C. STEAM DRIVEN GENERATORS

1—50 KW Crocker Wheeler 125 Volts, 2800 RPM direct coupled to a 80 HP Terry Turbine, 100 lb. pressure.

EXTRA SPECIAL

NEW! NEW! NEW!

New, open and totally enclosed, fan cooled 3 phase 60 cycle motors, in various makes and speeds, from 3 HP to 60 HP.

DIRECT CURRENT CRANE AND MILL MOTORS

Mfr.	Type	Speed	Volts
G.E. (2)	CO 1832	600	230
G.E. (2)	CO 1811	600	230
G.E. (2)	CO 1809	550	115
G.E.	CO 1807	800	230
G.E.	CO 1808	600	550
G.E.	CO 1806	875	230
G.E.	CO 1806	575	115
G.E. (2)	CO 1803	600	230
Whse.	K-10	525	230
West. (6)	K1,	950	230
West. (6)	K1	950	550
West.	HK3	800	230
West.	HK2	850	230
Whse. (5)	HK-5	700	230
West.	CK-9	835	230
North.	K-T 35 H.P.	800	230
P & H	12x8	430	230

The above items are constantly changing. Suggest you let us know your needs, if the item you want is not listed.

SYNCHRONOUS MOTORS

3 Phase 60 Cycle

H.P.	Mfr.	Volts	Type	Speed
250	Whse.	440		1200
250	G.E.	440	ATI-PB	720
187½	Whse.	220		600
175	G.E.	220	ATI-PB	514
175	West.	440		900
125	Cr. Wh.	220		900
100	Whse.	440/220		900

AC GENERATORS

3 Phase 60 Cycle

KVA	Mfr.	Volts	Type	Speed
300	G.E.	600	ATB-PB	600
225	G.E.	480	ATB-PB	720
225	Whse.	440/22	Pedestal	200
225	West.	2300		600
200	Lincoln	220		720
187½	Whse.	240	Pedestal	600
150	G.E.	240	ATB	514
150	Al. Ch.	440		900
100	Cr. Wh.	240		900
100	West.	240		900
7½	G.E.	220	AS	1800

SLIP RING MOTORS

3 Phase 60 Cycle

H.P.	Mfr.	Type	Volts	Speed
600	Whse.	CW	2200/ 550/440	590
400	G.E.	IM	2200/ 550/440	720
250	G.E.	IM	440	514
200	Cr. Wh.		2200	600
200	Whse.	CW	200	1150
150	G.E.	IM	2200	600
150	G.E.	IM	550	600
100	Wshe.	CW	440	600
75 (3)	G.E.	MT	440/220	1200
75 (2)	Cr. Wh.	SR	440/220	1200
75	Whse.	CW-746	440/220	1200
52	G.E.	ITC5012	440	900
50	G.E.	IM	440	900
50	Cr. Wh.		440	900
50 (2)	G.E.	MT	440/220	900
50	G.E.	I-M	440	1200
50	G.E.	MT-556Y	220	600
40	Al. Ch.		440	900
40	G.E.	MT	220	1200
40	Whse.	CW	2200	1750
40	Whse.	CW-636A	220	1160
40	G.E.	MT	550	900
40 (2)	Whse.	CW	550	900
37	G.E.	ITC5012	220	600
35	Ridgway		2200	600
35	G.E.	IM	2200	1200
35	G.E.	IM	2200	900
35 (2)	G.E.	IM	220	720
30	Fks. M.		220	1200
30	G.E.	MT 332	220	900
30 (2)	G.E.	MT-336	220	900
30	G.E.	MT-342	220	720
27	G.E.	IM	440	600
25	Al. Ch.		550	1800
25	G.E.	MT 536	550	720
25	Diehl	KK14R	220	850
20	Fks. M.		220	1200
15 (2)	G.E.	IM	220	1200
15	Al. Ch.	ARY	550	1200
15 (2)	G.E.	IM	220	900
15	G.E.	MT 312	220	900

A large assortment of smaller sizes as low as 1½ H.P.

SQUIRREL CAGE

3 Phase 25 Cycle

H.P.	Mfr.	Type	Volts	Speed
125	Whse.	CS	440	720
100 (2)	G.E.	IK	440	500
75	Whse.	CCL	550	480
40 (3)	Al. Ch.		550	3400
30	Whse.	CS	440/220	720
35	West.	M8	440	720
25	G.E.	IK	440	720
25	Ideal	A	440	720
25	West.	CS	440	720
20	G.E.	IK	220	720
20	West.	CCL	220	1500
20	Wagner		440	1500
20	West.	CS	440	600
20	G.E.	IK	440	1500
17½	Lincoln		220	1500
15	Whse.	CCL	440	500
15	Wagner	17TBP	440/220	1500
15	Ideal	A	440	1500
*15	Cent.	RS 308	220/110	1500
15	Ideal	AVE	440	720
15 (2)	Burke		440	1500
10	G.E.	IK	220	500
10	G.E.	KT 958	440/220	1500
10	Whse.	CCL	220	1500
10	Whse.	CS	440/220	750
10	Ideal	A-80	440	750
10 (2)	Whse.	CS-567	440/220	750
10	Whse.	CS	440/220	500
5 (2)	G.E.	KT	440	1500
5 (3)	West.	CS	440	1500

*Single Phase.

A large assortment of smaller sizes.

SPECIAL

150 Ton Overhead Crane 30' Span A.C. Drive with 2—25 Ton Auxiliaries.

SPECIAL! SPECIAL!

A.C. GENERATORS

31½ KVA, 25 KW, 120/208 V., 1200 RPM. Ball bearing with direct connected exciters and rheostats. Adaptable for direct connection to diesel, gasoline or electric motor drive.

SLIP RING

3 Phase 25 Cycle

H.P.	Mfr.	Type	Volts	Speed
150 (2)	G.E.	IM	440	600
150	Triumph	3-bearing	2200	720
100	G.E.	IM	440	720
25	G.E.	MTC 5323	440	720
15	G.E.	MTC-Hoist Duty	440	615
15	Whse.	HF	440	710
10	G.E.	MT 323	220	720
10	G.E.	MT 523	220	720

A partial listing.

SQUIRREL CAGE MOTORS

60 Cycle 3 Phase

H.P.	Mfr.	Type	Volts	Speed
300	G.E.		2200	600
225	G.E.	IK	2200	720
225 (3)	Whse.	CS	440	900
200	C.W.	IK	440	900
200	G.E.	IK	440	900
200	Burke	EM50	440	600
200	G.E.	IK	440	600
200	G.E.	IK	2200	514
200	Cr. Wh.		440	720
150 (2)	G.E.	IK	440	720
150	Al. Ch.		2200	1800
150	Al. Ch.		440	1800
150	Cr. Wh.		2200	600
150	Burke	EM°09	440	720
150	Al. Ch.		440	600
125	G.E.	IK	440	720
125	Cr. Wh.		2200	600
100	G.E.	IK	550	720
100	G.E.	IK	550	600
100 (4)	G.E.	I-L	550	720
100	G.E.	IK	550	900
100	G.E.	KT8	550	900
100	G.E.	KT846	440	1200
100	West.	CS	440	720
75	G.E.	I-L	440	360
75	G.E.	I-L	440	514
75	Al. Ch.		220	720
75	G.E.	I-K	440	720
75	G.E.	I-L	550	720
75 (2)	West.	CS	440	900
75	G.E.	Vert.	440	1200
60	Al. Ch.	8p. pr.	2300	1800
60 (2)	G.E.	IK	440/220	1200
60	F.M.	H	440	900
50	Al. Ch.		2300	900
50	Ridgway		2300	600
50	West.	CS	440	900
50 (2)	West.	CS	220	720
50	G.E.	KT552	440	720
40	G.E.	K	550	900
40 (2)	Al. Ch.		440	900
40	G.E.	I-L	440/220	900
40	Cr. Wh.		220	720
40	F. M.	H	220/440	900
40	Al. Ch.		440	1200
40 (3)	Al. Ch.	B. B	550	450

A large assortment of smaller sizes too numerous to ll

ALL EQUIPMENT GUARANTEED FOR ONE YEAR

★ **WANTED TO BUY: Stationary Air Compressors, Belt or Steam Driven**

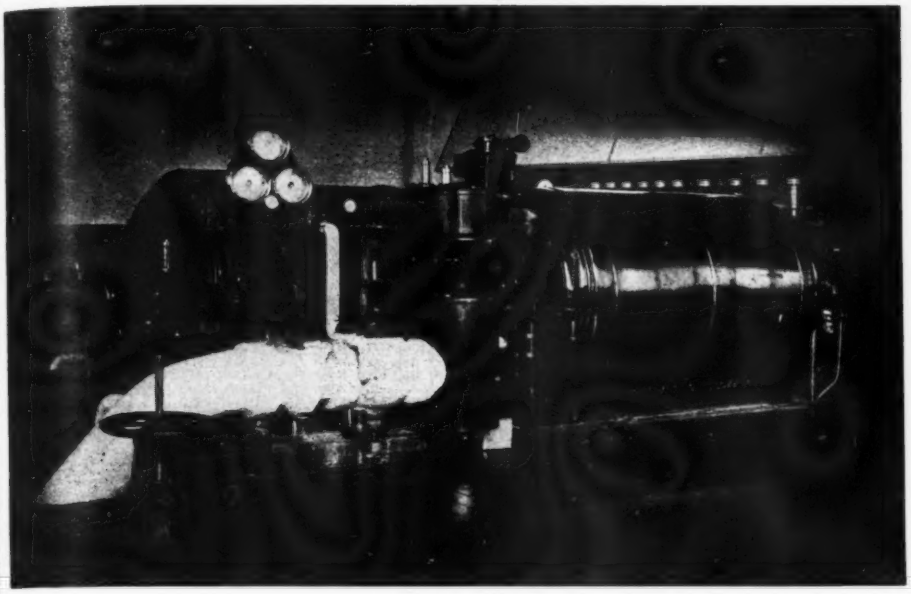
Benjamin's for Motors

ESTABLISHED 1904

Windsor 5-1700

12th AVENUE AND 37th STREET ★ BROOKLYN, 18, N. Y.

3125 KVA CONDENSING TURBINE-GENERATOR UNIT



ACTUAL PHOTOGRAPH

AVAILABLE IMMEDIATE DELIVERY

3125 KVA — 2500 KW 80% P.F. General Electric, 3 phase, 60 cycle, 2300 volt, 3600 RPM condensing turbine-generator unit, 180-200# I.S.P., 500° T.T., equipped with surface condenser, panels and instruments.

Excellent condition—a complete installation.

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

7800 KVA Westinghouse condensing 200 lb. pressure, 2300 volts, 1800 RPM complete with either surface or jet condenser.

6250 KVA Westinghouse condensing 175-200 lb. pressure, 2300 volts, complete with surface condenser.

1375 KVA G E. condensing 175-200 lb. pressure, 500° T.T., 6600 volts, 3600 RPM complete with condenser.

937½ KVA G.E. automatic extraction condensing, 175 lb. pressure, 125°F. superheat, 15 lb. gauge, 2300 volts, 3600 RPM—complete.

625 KVA G.E. condensing 200 lb. pressure, 2300 volts, 3600 RPM complete with condenser and auxiliaries.

375 KVA G.E. condensing 150-200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

375 KVA (2) G.E. non-condensing, 150-175 lb. pressure, 5 lb. back p essure, 2300 volts, 3600 RPM each complete with direct connected exciter.

125 KVA G.E. non-condensing, 110-125 lb. pressure, 0-10 lb. back pressure, 240 volts, 3600 RPM complete with switchboard.

ENGINE-GENERATOR UNITS

Direct Current

1000 KW Westinghouse, 250 volts, 514 RPM generator direct connected through reduction gear to Westinghouse condensing turbine, 150-200 lb. p r e s s u r e, equipped surface condenser.

600 KW Crocker-Wheeler, 250 volts, 300 RPM generator direct connected to a 14" x 18", 4 cylinder Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 5 lb. back pressure, complete with switchboard.

400 KW G.E. 125 volts, 165 RPM generator direct connected to a 26" x 28" Elliott Ridgeway Unaflow non-condensing engine.

300 KW Westinghouse, 250 volts, 175 RPM generator direct connected to a 24" x 26" Skinner Unaflow non-condensing engine.

150 KW General Electric, 240 volts, 200 RPM generator direct connected to Ames Unaflow non - condensing engine.

125 KW Elliott 125 volts, 250 RPM direct current generator, direct connected Elliott automatic engine.

75 KW, 125 volt, 1800 RPM Westinghouse direct current non-condensing turbine-generator unit.

ROTARY CONVERTERS

1500 KW Westinghouse synchronous 250 volts, direct current—6 phase, 60 cycle alternating current, 514 RPM

750 KW G.E. synchronous, 600 volts direct current, 6 phase, 60 cycle alternating current, 1200 RPM

330 KW G.E. synchronous, 600 volt direct current, 6 phase 60 cycle alternating current, 1200 RPM with 2300 to 408 volt transformers.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle—Alternating Current

312 KVA G.E. 2300/480 or 240 volt, 200 RPM generator direct connected to a Chuse 4-valve non-releasing Corliss engine.

312 KVA Elliott 4000 2300/550 or 240 volts, 180 RPM generator direct connected to a 17" x 24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

250 KVA Westinghouse, 2300 or 480 volts, 200 RPM generator direct connected Nordberg Unaflow engine.

75 KW 80% P. F., Elliott 480 volts, 225 RPM generator direct connected Elliott 4-valve engine.

MOTORS

—3 phase, 60 cycle

900 HP G.E. 240 volts, 900 RPM synchronous.

500 HP 80% P.F., G.E., 240 volts, 900 RPM synchronous motor with direct connected exciter.

150 HP G. E. form K, 2200 volts, 580 RPM squirrel cage.

125 HP 80% P.F. Elec. Mchy, 440 volts, 400 RPM synchronous.

60 HP G.E. 220 volts, 900 RPM squirrel cage induction complete with starting compensator.

50 HP G.E. type I, form M, 2200 volts, 1200 RPM slip ring.

50 HP Allis-Chalmers, 440 volts, 600 RPM squirrel cage.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers, 600 or 275 volt direct current generator direct connected to 2190 HP, 3 phase, 60 cycle, 4000/6600 volt, 300 RPM synchronous motor.

SPECIALS

2000 KVA G.E. 3 phase, 60 cycle, 480 volt, 300 RPM alternating current generator.

528 HP Heine A.S.M.E. code water tube boiler 350# pressure, 635°F., complete with stoker, superheaters —a complete installation—modern and practically new.

500 KVA G.E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

165 KW Electric Machinery, 3 phase, 60 cycle, 2400 volt, 514 RPM belted generator.

1—MODERN SLIGHTLY USED FAIRBANKS-MORSE FULL DIESEL UNIT CONSISTING OF:

350 HP, 5 cylinder, Model 32-D-14, vertical, 300 RPM engine direct connected to a 294 KVA, 3 phase, 60 cycle, 2400/550/440 or 240 volts alternating current generator.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO

WIRE OR PHONE
LONG DISTANCE 422

THE PICK OF POWER EQUIPMENT

TURBO UNITS—60 Cy.

1—15300 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 6000 KVA Westinghouse Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis Chalmers Cond.
1— 3125 KVA General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA Allis Chalmers Cond.
1— 2500 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA General Electric Cond.
1— 1500 KVA Allis Chalmers Non-C.
2— 1250 KVA General Electric Non-C.
1— 938 KVA West. 375# I.P. 100# B.P. N-C
1— 625 KVA General Electric Non-C.
1— 470 KVA Westinghouse Non-C.
1— 312 KVA Moore Non-Condensing
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1— 375 KVA Nordberg Uniflow
1— 340 KVA Skinner Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 250 KVA Ridgway 4-valve
1— 210 KVA Skinner Uniflow
1— 94 KVA Chuse Uniflow

D.C. STEAM ENGINE UNITS

1—350 KW Ridgway 4-valve 250 V.
1—300 KW Skinner Uniflow 250 V.
1—250 KW Ames Uniflow 250 V.
1—200 KW Ridgway 4-valve 250 V. 3-wire
1—150 KW Ames Uniflow 125 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire
1—100 KW Ames Uniflow 120 V.
1—100 KW Elliott 4-valve 250 V. 3-wire
1— 50 KW Ames Uniflow 125/250 V. 3-wire

OIL & GAS ENGINE UNITS—60 Cy.

1—500 KVA West. (gas) 40 V.
1—330 KVA DeLaVergne 2300 V.
1—312 KVA Anderson 2400 V.
1—200 KW Worthington 2300 V.
1—200 KVA Fairbanks Morse VA 2400 V.
1—187 KVA McInt.-Seymour 2300 V.
1—125 KVA Sterling Petrel (gas) 480 V.
1—121 KVA Fairbanks Morse 240 V.
1— 57.7 KVA Fairbanks Morse 240 V.
1— 37.7 KVA Caterpillar 120/208 V.

SURFACE CONDENSERS

1—20,000 sq.ft. Worthington
1—12,000 sq.ft. Worthington
1— 5,000 sq.ft. Westinghouse
1— 4,100 sq.ft. Ross
1— 2,310 sq. ft. Wheeler C. & E.

WATER TUBE BOILERS

1—750 HP Edge Moor 200-lb.
1—612 HP Stirling 250-lb., Pulverizer
2—560 HP Erie City 460-lb.
1—500 HP Stirling 250-lb., Stoker
1—500 HP Stirling 200-lb., Stoker
1—448 HP B. & W. 160-lb., Hand Fired
1—400 HP Wickes 200-lb., Stoker
1—335 HP B. & W. 200-lb., McClave-Brooks Stoker
4—200 HP B. & W. 200-lb., Hand Fired

A. C. GENERATORS

2—1500 KVA G.E. 25 cy. 2200 V. 750 RPM
2—1250 KVA G.E. 60 cy. 480 V. 750 RPM
1— 750 KVA G.E. 60 cy. 280-460 V. 300 RPM
1— 680 KVA G.E. 25 cy. 13200-4000 V. 300 RPM
1— 500 KVA G.E. 60 cy. 2300 V. 360 RPM
1— 360 KVA West. 60 cy. 240 V. 360 RPM
1— 94 KVA G.E. 60 cy. 2300 V. 600 RPM
1— 48 KW Elec. Mcy. 60 cy. 2400 V. 1200 RPM

SYNCHRONOUS MOTORS

2—1250 HP G.E. 25 cy. 2200 V. 750 RPM
2—1125 HP G.E. 60 cy. 480 V. 720 RPM
1— 850 HP G.E. 25 cy. 13200-4000 V. 300 RPM
1— 800 HP G.E. 60 cy. 440 V. 120 RPM
1— 778 HP G.E. 60 cy. 230-460 V. 300 RPM
2— 300 HP G.E. 60 cy. 220/440 V. 600 RPM
1— 150 HP Al. Ch. 60 cy. 440 V. 257 RPM
1— 100 HP G.E. 60 cy. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

4—3500 HP G.E. slip ring 2300 V. 120 RPM
1—1000 HP G.E. sq. cage 2300 V. 509 RPM
1— 600 HP G.E. sq. cage 440 V. 900 RPM
2— 400 HP G.E. slip ring 3800 V. 1800 RPM
2— 300 HP G.E. sq. cage 440 V. 600 RPM
2— 250 HP G.E. sq. cage 2300/4000 V. 1200 RPM

MOTOR GEN. SETS—60 Cy.

1—1500 KW Allis Chalmers 600 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 75 KW General Electric 125 V. DC
2— 70 KW General Electric 125 V. DC

ROTARIES—60 Cy.

1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
2— 750 KW General Electric 600 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.

FREQUENCY CHANGERS

2—3125 KVA West.25/62½ cy. 750 RPM
1—3000 KVA G.E. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1875 KVA G.E. 25/60 cy. 300 RPM
2—1250 KVA G.E. 25/62½ cy. 750 RPM
1—1250 KVA G.E. 25/60 cy. 300 RPM
1— 750 KVA G.E. 25/60 cy. 300 RPM
1— 750 KVA G.E. 60/25 cy. 300 RPM

SYN. CONDENSERS—60 Cy.

1—5000 KVA West. 5000 V. 720 RPM
1—2000 KVA C.W 11000 V. 600 RPM
2—1250 KVA G.E. 480 V. 720 RPM
1— 750 KVA G.E. 230-460 V. 300 RPM
1— 500 KVA West. 2200 V. 900 RPM

TRANSFORMERS—1 Ph. 60 Cy.

1—10000 KVA West. 120,000/66000-13200 V. 3 ph.
3— 750 KVA Pitts. 66000/33000 V.
6— 200 KVA G.E. 66000-13200/22800 V.
6— 250 KVA Penn. 34500-4600/2300 V.
9— 75 KVA G.E. 33000-13200/11000 V.
2—10000 KVA West. 26400-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
1— 6000 KVA West. 13200-2300 V. 3 ph.
3—1500 KVA Pitts. 22000-6600 V.
2—1000 KVA G.E. 23000/11500-575 V.
6— 833 KVA G.E. 22000-2300/4000 Y V.
3— 667 KVA Packard 23000-440 V.
3— 250 KVA G.E. 22000-11000 V.
6—1667 KVA Pitts. 13200-2300 V.
9—1000 KVA G.E. 13200-2300 V.
3— 200 KVA G.E. 13200-2300 V.
3— 667 KVA Moloney 11000-2300 V.
1— 150 KVA Pitts. 11000-2400 V.
3— 100 KVA West. 11000-250/125 V.
3—1250 KVA G.E. 6600-550 V.
3— 667 KVA G.E. 2300/4000Y-500/480/460 V.
1— 100 KVA G.E. 2300-230/460 V.

VOLTAGE REGULATORS

60 Cycle Induction

6—96 KVA 400 A. 2400 V. Gen. Elec.
1—72 KVA 300 A. 2400 V. Gen. Elec.
2—46 KVA 200 A. 2300 V. West.
6—36 KVA 150 A. 2400 V. Gen. Elec.
6—24 KVA 100 A. 2400 V. Gen. Elec.

OIL CIRCUIT BREAKERS

2— 600 A. 73 KV West. G222AS Outdoor
2— 400 A. 73 KV G. E. FKO 36 Outdoor
1— 400 A. 73 KV G. E. FHK036 Outdoor
6— 400 A. 37 KV G. E. FHK0136 Outdoor
4— 400 A. 34.5 KV Condit D-16-A Outdoor
2—1000 A. 30 KV Kelman CB76 Outdoor
4— 600 A. 15 KV G. E. FK060B
2— 400 A. 15 KV G. E. FHK0136 Outdoor
1—2000 A. 15 KV West. E6 Indoor
1—1500 A. 15 KV West. E6 Indoor
2—1500 A. QT KV G. E. FK12 Indoor
3— 600 A. 15 KV G.E. FK32C Indoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 CHURCH STREET, NEW YORK CITY 7, NEW YORK

JUST A FEW ITEMS OF OUR COMPLETE STOCK FOR IMMEDIATE SHIPMENT

PUMPS

G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
2400	55′	American	Centrif.
300	500′	Goulds	Triplex
240	460′	Worth.	Triplex
175	500′	Worth.	Triplex
500	175′	Blackmer	Rotary
430	231′	Kinney	Rotary
200	175′	Blackmer	Rotary
1600	460′	Platt	Steam
1000	460′	Knowles	Steam
500	460′	Knowles	Steam
2000	50′	Lawrence	Sump
300	231′	Gardner	Plunger

STEAM ENGINE GENERATOR SETS

BOILER FEED PUMPS

K.W.	Make	Volts	Type
100	Ames	240	dir. dr. Eng.
75	Ames	120-240	dir. dr. Eng.
50	Ball & Wood	125	dir. dr. Eng.
50	G.E.	250	dir. dr. Eng.
35	Sturt.	250	belt dr.
25	Greenfield	115	belt dr.
25	Ball & Wood	125	dir. dr.

MOTORS (D. C.)

100	Northwest	220	1750
25	Imperial	220	450
25	KW Fair. Morse	110	1050

STORAGE TANKS

5 to 30000 Gal. Steel Welded
5 to 1000 Gal. Steel Press.
15 to 300 Gal. Conden. Tanks

CONDENSATION RETURN UNITS

Nash-Jenn Dup. Vac. Heat. 26000EDR
Nash-Jenn Sump Vac. Heat. 16000EDR
Skidmore Vac. Heat. 20000EDR
Skidmore Vac. Heat. 8000EDR
Condensation Units 100 to 250,000EDR

AIR COMPRESSORS

C.F.M.	Pressure	Make	Type
850	100	Laidlaw	Hor. Dup.
500	60	Ing. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
250	100	Sullivan	Horiz.
220	100	Gardner	Gas Eng.

TURBO-CENTRIFUGAL BLOWERS

3000	16 lbs.	In. Rand	Motor dr.
2300	3 lbs.	Spencer	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
700	2½ lbs.	Allen Billmyer	Motor dr.
675	24 oz.	Spencer	Motor dr.
400	16 oz.	Spencer	Motor dr.
150	12 lbs.	Allen Billmyer	Motor dr.

BLOWERS

C.F.M.	St. Pres.	Makes	Type
100–60000	¼″–5″	Buffalo	Various
100–15000	¼″–16 oz.	American	Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press.	Make	Type
10000	2 lbs.	Roots	Belt dr.
6000	3 lbs.	Roots	Belt dr.
3000	3 lbs.	Roots	Belt dr.
2000	3 lbs.	Sturt.	Belt dr.
1000	3 lbs.	Roots	Belt dr.
200	5 lbs.	Baker	Dir. dr.
110	15 lbs.	Beach R.	Belt dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt dr.
350	27 in.	Worth.	Belt dr.
300	27 in.	Nash	Belt dr.
100	27 in.	Deane	Belt dr.
200	29 in.	Devine	Belt dr.

MOTORS (3 ph. 60 cy.)

H.P.	Make	Volts	Speed	Type
300	G.E.	2300/4000	1800	Syn.
175	G.E.	440	1150	I
100	Lincoln	220	1750	
50	Wagner	220	850	Syn. 2 ph
50	G.E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
40	G.E.	220	870	342
30	Wagner	220	850	sl. rg.
30	Wagner	220	1150	

STEAM ENGINES

11″x12″ G. E. Vertical
10″x10″ Sturtevant Vertical
10″x10″ Greenfield Vertical
3″x4″ Erie Vertical
7″x7″ Wickes Bros. Vertical
6″x6″ Lawrence Vertical
1 to 25 H.P. Steam Turbines

SIMILAR EQUIPMENT IN STANDARD MAKES AND SMALLER SIZES
HIGHEST PRICES PAID FOR YOUR SURPLUS EQUIPMENT

SUPERIOR EQUIPMENT CO.

140 Grand St., N. Y. C. Tel. CAnal 6-6983-4

ELECTRICAL and POWER EQUIPMENT

MOTORS

230 VOLT, DIRECT CURRENT

CONSTANT SPEED

Qu.	H.P.	Make	Type	RPM
1	450	Al. Ch.	Int	425
1	150	G.E.	RC	1700
1	125	G.E.	DLC	550
2	100	Al. Ch.	CPD INT	1000
1	100	Rel.	1050T	500
1	75	G.E.	DLC	525
2	50	West.	SK160	565
1	40	G.E.	RC15A	700
1	30	West.	SK120	975
2	30	G.E.	RC31B	1150
1	30	West.	SK140	600
3	25	West.	SK120	825
8	25	G.E.	RC31	1150
1	25	West.	SK	850
1	20	G.E.	RC11	1150
3	15	G.E.	RC10	1150
5	15	West.	SK 100 I	675
7	15	Rel.	92T TE.BB	850
2	15	West.	SK90	850
4	15	G.E.	RC11	850
3	10	G.E.	RC29	1150
8	10	G.E.	RC29	850
3	10	West.	SK80	750
2	7½	G.E.	RC	1150
9	5	West.	SK40	850

VARIABLE SPEED

Qu.	H.P.	Make	Type	RPM
3	150	Diehl.	K15	400/800
3	25/100	G.E.	MPC	300/600
1	110	West.	SA	650/1050
1	100	West.	SA	250/350
1	75	G.E.	LC	650/900
2	40	G.E.	LC	650/1300
3	30	West.	SK140	600/1200
1	25	West.	SK	400/1200
1	15	West.	SA9	300/1200
1	15	West.	SK103	400/1600
2	15	West.	SK	500/1500
2	10	Al. Ch.		500/1000

SQUIRREL CAGE

A.C. 3 PH 60 CYCLE 2300 VOLT

Qu.	H.P.	Make	Type	RPM
1	150	G.E.	IK	900
2	100	West.	CS774C	900
1	100	G.E.	IK	514

220/440 VOLT

1	125	Cr. Wh.	125Q	900
1	50	Wagner	22VRM	600
1	40	Rel.		900
5	30	Wagner	19VRM	720
2	20	Rel.	120AA	900
1	20	Rel.	178AA	720
1	15	Gent.	SCN19	1200
3	3	Imp.	TE. BB	3600
5	1	Wagner	BB	1200

TRANSFORMERS

60 CYCLE, SINGLE PHASE

9—333 Kva Pitts. 13200/575 oil cooled.

3—100 Kva Pitts. 2400/240/120 oil cooled.

4—5 Kva Wsghse 2300/230/460 air cooled.

6—3 Kva Gen. Elec. 2300/230/115 air cooled.

GENERATORS

230 VOLT DIRECT CURRENT

45 KW Diehl K 18 550 RPM.

100 KW Ft. Wayne MPL 550 RPM.

100 KW GE MPL 600 RPM.

200 KW Sprague 525 RPM.

200 KW West. 500 RPM.

250 KW West. 500 RPM.

750 KW GENERATOR

750 KW—Ridgeway, 1800 RPM, 230 V., D.C., Compound Interpole, two bearing, PRACTICALLY NEW.

BOILERS

4—1010 HP. Watertube boilers, 250 lb. pres., steel headers, long drums. ASME Code—complete with oil burning equip., pumps, Foster superheaters and accessories.

2—316 HP. Heine Watertube boilers, 160 lb. pres., hand fired.

2—684 HP Edgemoor Waste Heat Boilers, 200 lb. pres. complete with Economizers, Super Heaters, motor driven blowers and steel stacks.

2—500 HP Edgemoor, 200 lb. pres., ASME Code, with Riley Side Dump Stokers.

STOKER

1—Jones, 3 retort, steam actuated, underfeed, ram stoker.

CONDENSER

1—C. H. Wheeler 3650 Sq. Ft. Surface Cond. 2 pass. complete with pumps.

PUMPS

Cameron Centrifugal Purchased New 1923. Bronze fitted, mounted on common subbase for motor drive—

1—Size 14—700 RPM 4700 GPM 35' head 60 HP.

1—Size 14—720 RPM 5500 GPM 30' head 75 HP.

1—Size 16—350 RPM 3500 GPM 45' head 125 HP.

All Pumps Tested Hydrostatically for 125#.

All Double Suction Volute. Gate Valves Attached,

1—Davidson 14x9¼x16 Simplex Double acting piston pattern, brass fitted.

STEEL TANK

350,000 gal. Steel Water Storage Tank 40' high, 40' dia.

FEEDWATER HEATER

1—Cochrane Feedwater Heater 5000 H.P., open type.

OVERHEAD CRANE

1—15 Ton, OVERHEAD CRANE, 50 ft. span overhead Travelling Crane, Electric lift, hand travel.

MOTOR GENERATOR SET

1—35 KW GENERAL ELECTRIC Motor Generator Set. 125 Volt D.C., 1200 R.P.M., R.C. Generator; Motor General Electric KT, 550 Volt, with compensator and D.C. Panel.

WATER WHEELS and GENERATORS

2—45" HERCULES Cylinder Gate Type B Water Wheels. Complete with Governors, pumps and tanks. Each direct-connected to a WESTINGHOUSE ELECTRIC Vertical Generator 800 KVA, 3 ph., 600 V. 40 cy. 150 R.P.M.

HEAT and POWER Company, Inc.
45 BOND STREET Phone: ALgonquin 4-3874 NEW YORK, 12, N. Y.

MOTORS • GENERATORS • TRANSFORMERS

Prices on Application

3 PHASE, 60 Cycle, 220/440 V.

HP	Make	RPM	Type	Frame
7½	Gen. Elect.	1200	KT	952
10	Gen. Elect.	720	K	404
10	Gen. Elect.	900	KT	312
15	West.	1800	CS	
20	Gen. Elect.	900	KG	405
20	Armor	900	ball bearing	
20	Fairbanks Morse	900	ball bearing	
20	Fairbanks Morse	1200 600	two speed	
25	Westinghouse	900	CS	444
30	Armor 2-phase	720	ball bearing	
40	Westinghouse	1800	CS	
50	Gen. Elect.	1800	IK	
50	Westinghouse	900	CS	505
50	Westinghouse	900	CS	646A
50	West.	1800	CS	
60	Gen. Elect.	1800	I	form K
75	Gen. Elect.	1800	I	form K
75	Gen. Elect.	900	KT	552
100	Gen. Elect.	1800	I	form K
100	West.	1800	CS	
150	Gen. Elect.	1200	I	form K
150	Gen. Elect.	1200	I	form K

TRANSFORMERS

Amt.	Kva.	Make	Cycle	Voltages
3	25	Gen. Elect.	25	2300/115/230
3	50	Gen. Elect.	25	2300/115/230
3	75	Gen. Elect.	60	4600/230/460
3	100	Gen. Elect.	25	2370/115/230/460
2	150	Westinghouse	25	2300/115/230/460
3	200	Gen. Elect.	60	2300/230/460
3	250	Gen. Elect.	60	13,000/2300
3	250	Westinghouse	60	11500/460
2	333	Westinghouse	60	2300/230/460
3	500	Pittsburgh	25	11,000/220
4	833	Allis Chalmers	60	13,200/440
3	1000	Pittsburgh	60	2300/4600/230/460

SPECIAL

3—250 KVA. Westinghouse Transformers Type SL 11,500 volts Primary 460 volts. Secondary, 60 cycle 1 phase. Used less than 1 year.

Mine Slope Hoist

1—Connellsville Mfg. and Mine Supply Hoist storage capacity for 11,000 feet 1" Rope—Speed 900' per minute.
Motor—500 HP Gen. Elec. Mt. Slipring 3/60/2200/450 RPM. Complete with remote control, Herringbone reduction gears and demountable base and drum.
Write Wire Phone
Inspection can be made for 30 days in operation. This machine almost new.

MOTOR GENERATOR SETS

1—125 KW Ridgeway 250 V. DC. 1200 RPM Motor 3/440/60/1200 Complete.
1—100 KW Westinghouse Synchronous-Generator 250-275 V. DC—Motor 3/60/2300/900 RPM complete with panels.
1—150 KW Westinghouse Synchronous-Generator 250-275 V. DC. Motor 3/60/2300/900 RPM complete with panels.

3 PHASE, 25 CYCLE, 220/440 VOLTS

HP	Make	RPM	Type	Frame
5	Al. Chal.	720	AR	
5	Wagner	1450	Ball B.	Enclosed
7½	West.	750	CS	
7½	G.E.	1500	KT	181
10	G.E.	750	KT	312
10	West.	750	CS	
10	West.	1500	CS	
10	G.E.	1500	I	Form K
15	G.E.	750	KT	
15	West.	1500	CS	
20	West.	750	CS	
25	West.	750	CS	
50	G.E.	750	I	Form K
50	West.	750	CS	
75	G.E.	750	KT	357
75	G.E.	750	I	Form K
100	G.E.	300	I 17	Form K
150	G.E.	750	I	Form K
150	G.E.	750	I	Form K
200	West.	460	CS	2200 Volt
200	G.E.	750	I	Form K
225	Elec. Ma.	500	2200 V.	Synchron
1150	G.E.	375	2300 V.	Synchron
200	West.	235	CW	Slipring

Prices on Application

SLIPRING MOTORS

60 CYCLE, 3 PHASE, 220/440 VOLTS

HP	Make	Speed	Type	Frame
10	Gen. Elect.	1800	MT	303
15	Gen. Elect.	1800	I	form M
20	Gen. Elect.	545	MT	332
20	Westinghouse	575	CW	648A
20	Westinghouse	575	CW	ball bearing
25	Westinghouse	690	CW	
30	Gen. Elect.	1800	MT	327
30	Gen. Elect.	1800	I	form M
40	Westinghouse	690	CW	748
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	748A
50	Westinghouse	900	CW	
60	Westinghouse	720	CW	2200 volt
75	Westinghouse	1800	CW	
500	Westinghouse	600	CW	

SPECIAL

2—500 HP. Gen. Elec. Motors, Type I, Form K, 3/60/440/900 RPM, with Starting Compensators.
1—500 HP. Gen. Elec. Motor, Type KTP, 3/60/440/1200 RPM with Starting Compensator.

2—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM. direct connected to Generator 3/62½/440 V. Complete with exciters and panels.
1—200 KW General Electric 3 ph., 60 cy., 2300 V. direct connected to 290 HP. Gen. Elec. Synchronous Motor, 3 ph., 25 cy., 440 volt, 750 RPM. Complete with panels.

150 HP D.C. MOTOR

150 HP. Westinghouse Type SK, 180L, 230 V., 1100 RPM, Compound Interpole. Serial No. 2221504.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

Electrical Equipment In Stock Rebuilt and Guaranteed

230-VDC. CRANE & MILL MOTORS

(Series and Compound)

H.P.	Make	Type	R.P.M.
1—1	F. & H.	5 x3'	850
2—2	Shaw	Class P.E.	930
1—2	G.E.	C.O.-2502	750
1—2 (new)	Reliance	T-224	1600
4—3	Shaw	B.F.	750
1—3	G.E.	C.O.-2503	975
1—7/10	G.E.	M.D.-102	1025 800
1—7	G.E.	C.O.-1805	700
1—10	C.W.	B.W.	650
1—20 •	G.E. (115-V)	C.O.-2504	850
2—20/30	G.E.	M.D.-104 (C.P.)	725/575
3—25	G.E.	C.O.-1809	850
2—30/45	G.E.	M.D.-104 (C.P.)	625/500
1—50	G.E.	C.O.-1810	725
1—50/65	Westgshe	MCA-460	475/425
2—65/85	G.E.	C.O.-1830	700 650
1—85	G.E.	C.O.-1811	550

(All Motors Are Series Wound Except Where Marked C. P. Compound)

ELECTRIC BRAKES AND CONTROL EQUIPMENT

2—Cutler Hammer, Type M, size 0, 230-VDC.
1—10-HP., P&H, 230-VDC., 9"x5½" wheel.
2—25-HP., G.E., 220/440VAC., type CR-9510.
2—**NEW** Westghe., Type DI, 104-F, 230-VDC. Shunt.
1—50-HP., G. E., 220/440VAC. type CR-9510-414-107.
1—**NEW** Clark, Type C, size 18, 230-VDC. series.
1—80-HP., G.E., 220-440-VAC., type CR-9510-414-110.
2—Clark, Type 3-C, size 24, 230-VDC., shunt.
20—Practically new G.E. drum controllers, 230-VDC., type R-177-A with 35-HP. banks of resistance.
75—(MISC) 230-VDC., 220/440-VAC., drum controllers 5 to 75-HP.

SPECIAL:

(3)—EC&M Youngstown Limit Switches.
(1)—EC&M Magnet control, 230-VDC. master controller, contactor and resistor.
(1)—Spring type magnet cable reel with rubber covered cable.

GENERAL PURPOSE 230-VDC. MOTORS

H.P.	Make	Type	R.P.M.
2—2	Allis. Chal.	E-50	1750-SH.
1—3	G.F.	CD-55	1150-SH.
1—3	Reliance	T-224	3500-SH.
3—5	Westgshe	SK-40	850-SH.
2—5	Westgshe	SK-30	1100-Comp.
4—5	Westgshe	SK-30	1100-SH.
2—7½	Westgshe	SK-60	850-Comp.
1—7½	Westgshe	SK-40	1150-SH.
1—10	Westgshe	SK-50-L	1300-SH.
1—15	Allis. Chal.	Shunt	800
1—15	C.W.	Size 15-J	800-Comp.
1—15	G.E.	CD-75	1750-SH.
2—25	Westgshe	SK-100-L	1100-SH.
1—40	Reliance	RH-992	1200-Comp.
1—75	Westgshe	SK-160	850-Comp.

230-VDC. VARIABLE SPEED MOTORS

H.P.	Make	Type	R.P.M.
1—2	G.E.	RF	500/2000
1—3	G.E.	RLC-111	750/1500
1—3½	G.E.	RLC-112	600/1800
1—5	Westgshe	SK-33	1150/1650
1—7½	Westgshe	SK-103	400/1600
1—8	Westgshe	SK-1001	300/1200
1—10	G.E.	RF-10	400/1600
1—20	G.E.	RC-12	400/1200
1—25	Reliance	310-T	300/1200
1—70	Reliance	461-T	600/1200

(Auto Control Panels With Most of These Motors)

220/440-VOLTS, 3-PHASE, 60-CYCLE MOTORS

(GENERAL PURPOSE)

H.P.	Make	Type	R.P.M.
1—1½	G.E.	K.T.-180	1800/1200/900/600
2—3½	G.E.	K.T.-180	1800/1200/900/600
(Above With Special G.E. Drum Controls)			
1—5	G.E.	K-254(vert)	1735
1—7½	Sprague	MT-181	1800 (S.R.)
2—7½	Louis Allis	OX-28	1740
1—7	Westgshe	C.S.	1200
1—10 20	G.E.	KT-522-Y	600/1200
1—10	F.M.	OS-FW-324	1740
1—12½/25	Westgshe	C.S.	880/1730 (A.C.)
1—20	C.W.(B.B.)	ALS-401	1150 (A.C.)
1—20	G.E.	I	1200
1—25	Westgshe	C.S.	900
1—25	F.M.	H-12-B	900
2—25	F.M.	H-12-A	1200
1—25	G.E.	KF-405	1170
2—25	G.E.	KT-326	1200
1—35	F.M.	H-12-B	1200
1—35	G.E.	I-form-K	1800
1—50	G.E.	KT-346	870
1—75	Westgshe (S.R.)	C.W-753-C	870 (A.C.)

(B. B. Ball Bearing; S. R. Slip Ring; A. C. Automatic Control)

SPECIAL:

14—Master Electric Motors, Explosion Proof, Fan Cooled, 2-HP., 1725-RPM. 220/440-V., 3-PH., 60 CY., Ball Bearing, with Mercury Clutch, Master-Speed Ranger, Speeds 700-900-1060, 1260-1500-1780-2100-RPM.

T. B. MacCABE COMPANY

4306 CLARISSA ST. PHILADELPHIA 40 PA.

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N. Y.

A C TURBINE UNITS

6250 KVA G.E. 2300 V., cond.
4000 KVA Al. Chal. 2300 V. cond.
3125 KVA G.E. 4100/2300 V. cond.
2500 KVA G. E. 2300 V. cond.
2500 KVA Al. Chal. 440 V., cond.
1875 KVA Al. Chal. 2300 V. cond.
1250 KVA (2) G. E. 2300 V. cond.
940 KVA Wghse. 6600 V. cond.
937 KVA G. E. Auto BLEEDER, 2300 V.
937 KVA G. E. 2300 V., cond.
937 KVA Al. Chal. 2300 V., 300#.
780 KVA Al. Chal. 2300 V., cond.
625 KVA Wghse. 2300 V., cond.
375 KVA G. E. 2300 V., cond.
312 KVA Elliott 480 V., cond.
250 KVA Al. Chal. 480 V. Auto BLEEDER.
150 KVA Wghse, 240 V. cond. (Non-Cond.)
375 KVA G.E. 2300 V.
312 KVA C.W.—Moore, 450#, 240 V.
175 KVA Al. Chal.—Sturtevant 220 V.
75 KVA Al. Chal., 240 V.

STEAM ENGINE SETS (A C)

500 KVA (2) G. E.—24 x 48 Bates Corliss.
490 KVA Wghse.—Hamilton Cross Comp.
420 KVA Wghse.—Erie Ball Cross comp.
375 KVA G. E.—22 x 27 Erie Ball, 4 V.
210 KVA G. E.—19 x 20 Skinner Unif.
150 KVA G. E.—16 x 15 Skinner Unif.
150 KVA G. E.—16 x 36 Skinner S. V.
125 KVA G. E.—12 x 21 Hamilton 4 V.
100 KVA G. E.—14 x 15 Skinner Unif.

DIESEL ENGINE SETS

500 KVA Wghse.—Busch Sulzer
375 KVA Wghse.—Busch Sulzer
312 KVA G. E.—Anderson
312 KVA G. E.—McIntosh Sey.
200 KVA G. E.—Busch Sulzer
170 KVA F. M.—F. M. "VA"
140 KVA E. M.—Fairbanks Morse "V"
121 KVA F. M.—F. M., 32-E
100 KVA C. W.—Bessemer
90 KVA (4) F. M.—F. M. "VA"
75 KVA Al. Chal.—Caterpillar

BELTED

240 HP Fairbanks 35-E 6 cyl.
80 HP (3) Fairbanks Style V. A.

GAS UNIT

44 KVA Caterpillar, 3-60-220 v.

SPECIAL

937 KVA G. E. 3-60-2300 V., Auto BLEEDER. With complete equipment.

937 KVA G. E. 3-60-2300 V., Condensing. With complete equipment.

W T BOILERS

749 HP (2) Edgemoor, 200#
728 HP Erie City, Ver. 200#
600 HP Connelly, 200#
600 HP Heine, 200#
522 HP Sterling, 207#
471 HP Erie City Ver., 160#
396 HP B. & W., 160#
275 HP Heine 150#
250 HP Sterling, 160#
200 HP (2) Scotch Marine, 15#

PUMPS (MOTOR DRIVEN)

7500 GPM, 80' head
4000 GPM 70' head
3600 GPM 85' head
3250 GPM 425' head
3000 GPM 100' head
3000 GPM (2) 65' head
1390 GPM 231' head
850 GPM 243' head
750 GPM Hill 231' head
350 GPM 720' head

STEAM ENGINE SETS (D C)

450 KW C. W. 250 V.—Nordberg Unif.
300 KW G. E.—Skinner Unif.
150 KW G. E.—Erie Ball 4 V.
100 KW G. E.—Erie Ball 4 V.

AIR COMPRESSORS

2200 CFM Nordberg 100#, steam and motor driven
1080 CFM Nordberg 85#,—motor
Steam driven—all sizes
Gas driven—80-100 HP, 200/300#

TRANSFORMERS

687 KVA (2) Maloney 13800-460 V.
500 KVA (3) Al. Chal. 33000-440 V.
500 KVA (2) G. E. 11950/6900-230/460 V.
250 KVA (2) G. E. 6600-2300 V.
150 KVA (2) Maloney 2300-230/460 V.
150 KVA (2) Furnace Type 6600-90
100 KVA (3) Al. Chal. 22000-440 V.
100 KVA (2) G. E. 13200/6600-440/600 V. & small sizes.
3 Ph. Transformers
750 KVA Wagner 6600-2200 V.
500 KVA (4) G. E. 13200-120/208 V.
300 KVA (2) G. E. 13200-120/208 V.

BOILERS

1—528 HP Heine, 350 lb. with underfeed-stoker.
1—335 HP B & W Sectional Header Boilers, 200# pressure with superheaters, hand fired grates.
1—250 HP Casey-Hedges, 160 lb. pressure.
1—400 HP Wickes 3 drum low head boiler, 200# pressure with Chicago Spreader stoker. Installed 1932.
1—90,000# per hr. Badenhausen Boiler, 354# pressure.
1—357 HP HEINE with Riley Underfeed Stoker.
2—600 HP B & W sectional header boilers, 200# pressure.
2—300 HP Heine 175# pressure.
2—492 HP Sterling Boilers, 160# pressure.
6—600 Hp 200# pressure O'Brien boilers.
1—394 HP Sterling Boiler chain grate stoker, 160# pressure.
1—585 HP Erie City vertical boiler 185# pressure, Type E. stoker.
2—253 HP Sterling Boilers, 160# pressure with oil burners.
1—444 HP Union Iron Works Boiler, 225# pressure.
2—500 HP Edge Moor Boilers 200# pressure.
4—500 HP Voigt Water Tube Boilers 175# pressure with chain grate stokers and all auxiliaries.
1—440 HP B & W Sectional Head Boiler 150# pressure, underfeed stoker.
1—522 HP Sterling Boiler 200# pressure with Firite Stoker.
2—600 HP Stirling Boilers, 200 lb. pressure.
1—484 HP Springfield Boiler, 250# pressure oil burners.
2—309 HP Heine Marine boilers 225# pressure.
2—350 HP Stirling boilers with auxiliaries.
2—309 HP Heine Marine Boilers, 223#
8—150 HP HRT Boilers, 150# pressure.
4—750 HP Bigelow Hornsby 225# pressure with pulverizers.
4—1010 HP Heine watertube boilers 250# pressure.
1—400 HP Connelly Boiler 160# pressure with new tubes and auxiliaries.
4—72" x 18' HRT boilers including a 637 KVA General Electric condensing turbine. Complete plant.
1—150 HP HRT, 125# pressure, rebuilt and guaranteed.
56—50 HP Vertical Boilers 150# pressure all auxiliaries.

TURBINES

2—5000 KW Westinghouse 1800 RPM 3-60-2300 volts Surface Condenser all auxiliaries.
1—3200 KW Allis-Chalmers Condensing Turbine with auxiliaries.
1—2500 KW General Electric Condensing Turbine with auxiliaries.
15,000 KVA Westinghouse turbine, condenser.
1—1000 KW Westinghouse non-condensing turbine 350# pressure, 16# back pres.
1—937 KVA Allis-Chalmers Turbine.
1—625 KVA General Electric Turbine with jet condenser.
1—2000 KW Westinghouse Turbine with Surface Condenser and auxiliaries 3-60-440 volts.
1—300 HP Kerr Non-condensing 3600 RPM Turbine.
1—250 KVA Waite Turbine either condensing or non-condensing.
1—250 KVA General Electric non-condensing Turbine.
1—125 KW General Electric non-condensing Turbine.

ENGINE GENERATOR SETS

260 KVA Skinner uniflow engine.
1—750 KVA Rice & Sargent 3-60-600 volt engine generator.
2—200 KW 250 volt D.C. engine generator sets.
1—250 KVA Ridgeway engine generator set.
1—500 KVA Allis-Chalmers Corliss.
17 inch by 18 inch Skinner uniflow engine.
1—166 KVA Ames Uniflow engine generator set.
1—260 KVA Skinner uniflow engine.
2—625 KVA Bates Corliss engines.
1—48" x 150' steel stack.

DIESEL ENGINES

2—200 KVA Fairbanks-Morse Full Diesel Engine Generator.
4—312 KVA MAN full diesel engine generators, solid injection, 4 cycle.
1—Busch Sulzer Full Diesel direct connected 1335 KW AC generator, rebuilt and guaranteed.
1,250 KVA Nelesco engine generator.

ENGINE GENERATOR SETS

1—625 KVA Nordberg Uniflow engine.
1—1000 KVA Skinner Uniflow engine.
400 KW Skinner Uniflow Engine Generator set.

MISCELLANEOUS

54,000 pound Cochrane hot process lime and water softener.
2500 HP Cochrane Open Feed Water Heater.
1—10' x 15' Illinois Forced Draft Chain Grate Stoker.
1—#8 Fuller Bonot Pulverizer.
1—8 retort Taylor, brand new stoker.
1—800 HP Hoppes open feedwater heater.

SEE Fletcher FIRST!

FLETCHER SALES CO.

325 Fincastle Building LOUISVILLE, KY.

SLIP RING MOTORS, 3 PH., 60-CY.

HP	Volts	Make	Speed
900	2300	G.E.	900
850	2300	Whse	514
450	2300	G.E.	600
400 (3)	400	Whse.	514
400	2300	Whse.	1200
350	220-440	G.E.	1800
350	2200	G.E.	600
300	2300-4000	G.E.	1200
250	2300	G.E.	600
250	440-550	G.E.	600
200	2200-550	G.E.	1800
300	2200-400	G.E.	600
150	440-220	G.E.	1800
150	2300	G.E.	900
150	440	G.E.	1800
150	550-2200	G.E.	1800
125	440-220	G.E.	600
100	550-2200	G.E.	720
100	440-220	G.E.	1800
100	220-440	G.E.	720
100	220-440	G.E.	900
75	220-440	G.E.	600

SYNCHRONOUS MOTORS, 3-PH., 60-CY.

600	2200	Whse.	900
400	440-220	Whse.	375
350	440-220	G.E.	900
240	2300-440-220	G.E.	600
208	2300-4000	G.E.	1200
150	2200	G.E.	1800
110	440	Whse.	900

PUMP

1—8" Dredge Pump 1880 GPM, 120' Morris Machine Works with direct connected Slip Ring Motor 125 HP, 600 RPM, G.E.

OUTDOOR OIL CIRCUIT BREAKER

1—New 400 Amp. Type FK, 136-1328A, General Elec. 3PST, 25,000 Volt Oil Switch, Interrupting Capacity 125,000 KVA, complete CT's PT's, etc.

TRANSFORMERS—60 CYCLE

2—667 kva., G.E., 2300/4000-460/480 Volts.
2—667 kva., Whse., 22000-2300.
3—500 kva., Whse., 22000-2300.
3—350 kva., G.E., type H-KD 13200-4600.
3—333 kva., G.E., type H-KDD 2400-460/230.
3—250 kva., Whse., 13,800-460.
3—200 kva., G.E., type H 10000-600.
3—200 kva., G.E., H-KD 6600-2300/4000Y., 25 cy.
3—175 kva., G.E., 4000-480.
3—150 kva., G.E., type H-KDD 13200/2300.
3—150 kva., Al. Chal., type OISC 10400-2400.
1—100 kva., Pittsburgh, type OISC 2400-240-120.
3—100 kva., G.E., type H 2400-240-480.
2—100 kva., G.E., type H-KD, 6900/11950Y-230/115.
3—100 kva., Whse., 22,000-2300.
2— 75 kva., G.E., type HK, 2300-220/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse., type SK, 13800-240/120.
2— 50 kva., Whse., 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
550	440/220	G.E.	IK	900
400	440	G.E.	KTP	1200
400	2200	Whse.	C.S.	1800
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IK	600
200	220/440	G.E.	IK	600
150	2200	Allis. Ch.	AN	720
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
50	220/440	G.E.	K	1800

MOTOR GENERATOR SETS

75 KW, 125 V, 1200 RPM Westinghouse Conn. to 112 H.P. 2500/440 V, 3 ph, 60 cy. Ind. motor.
1—75 KW 125 V, 1200 RPM, GE Conn to 100 HP 440 V. 3 ph. 60 cy. Ind. motor.
1—75 KW 250 V, 1800 RPM, Cr. Wh., Type CCD con. to 100 H.P., 2200 V., 3 ph., 60 cy. syn.
1—60 KW 250 V, 900 RPM, Whse. SK 607 to 75 HP 440/220 V. 3 ph. 60 cy. Ind.

A.C. GENERATORS

1—500 kva., 900 r.p.m., 2300 V. Whse. Condenser.
1—300 kva., 900 r.p.m., 240/480 V., G.E.
1—225 kva., 600 r.p.m., 2300-240 V., G.E.
1—187 kva., 900 r.p.m., 2300-550 V., Westghse.
1—110 kva., 900 r.p.m., 440 V. G.E.
1— 25 kva., 3600 r.p.m., 220 V. G.E.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

TURBO GENERATOR

1—750 KW. Gen. Elec. 3 ph. 60 cy. 2300 volt 3600 rpm. complete with CH Wheeler surface condenser, radiojet pumps, etc.

1—500 KW Gen. Elec. non-condensing

1—450 HP Moore Bleeder Turbine 20 lbs extraction

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit Breakers, etc. Please send us your inquiries. What have you for sale?

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8403 Hegerman St. Phil. 36, Pa.

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1—5000 KW GE Cond. 2300 V.
1—4000 KW GE Cond. 2300 V.
1—3000 KW GE Cond. 600 V.
1—1250 KW West Cond. 440 V.
1— 750 KW West Cond. 6600 V.
1— 600 KW GE Cond. 600 V.
1— 500 KW GE Cond. 600 V.
1— 500 KW GE Cond. 125 V. DC.
1— 200 KW GE Cond. 2300 V.
1— 100 KW GE Cond. 600 V.
1— 75 KW GE N.C. 125 V. D.C.

Turbines Only

1—450 HP GE 175#
1—210 HP Terry 250#
1—175 HP GE 110#

Boilers

1—750 HP Heine 200# Stoker
3—318 HP Manning Type 170#
1—300 HP Heine 250# Stoker
2—100 HP HRT 125#
2—150 HP HRT 150# Grates

Air Compressors

1—1214 CFM 100# Motor Driven
1— 732 CFM I.R. 100# Belted
1— 825 CFM 100# Steam Driven
1— 600 CFM 500# Steam Driven
1— 386 CFM I.R. Steam Driven

Centrifugal Compressors

10000 CFM 33# Turbine Driven

Pumps

2—300 GPM 65' Hd. Motor Driven
1—1500 GPM Fire Pump Steam
1—1000 GPM Fire Pump Steam

Engine—Generators

1—600 KW GE 2300 V.

Belted Generators

1—550 KW GE 360 RPM 2300 V.
1—450 KW GE 360 RPM 600 V.
1—15 Ton Crane Hand Operated
1—150 HP Motor 720 RPM 2200 V.

Also transformers, engines and cranes

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A. LEE ELLIS CO., U. S. Mchy. Bldg., Boston, Mass.

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Large selection—All sizes and types. Generator units, marine engines, gasoline engines, auxiliaries—also boilers, steam engines, turbo generators.

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Phone—Worth 2-0455

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250 K.W., A.C., type ATI-32-312M-225, Form S, 225 RPM, P.F. .8, 75.5 amps., 3/60/2300 volt. Pedestal sole plates. Includes G.E. exciter 17½ KW, type RC compound wound & switchboard.

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Main 4—3804—5

Motor Generator Sets—Synchronous Motors, Etc.

M-G SETS

1—West. 500 KW 275 or 600 Volt D.C. 720 RPM, 2300 Volt 80% P.F. 720 HP A.C.
1—Allis-Chalmers 50 KW 250 Volt D.C. 1200 RPM 2300 Volt 75 HP synchronous
1—Allis-Chalmers 300 KW 250 Volt D.C. 600 RPM, 2300 Volt 450 HP .8PF Motor

VERTICAL MOTORS

1—G.E. 50 HP 1200 RPM 3 phase 60 cycle 220 Volt
1—Reliance fan-cooled 25 HP 1750 RPM 220/440 Volt

SYNCHRONOUS MOTORS
3 phase, 60 cycle, A. C.

1—Burke 300 HP 900 RPM 440/220 Volt
1—Ideal 250 HP 600 RPM 440 Volt 3-bearing
1—Ideal 50 HP 600 RPM 2300 Volt

SLIP RING MOTORS, 3 phase, 60 cycle

G.E. 60 HP 600 RPM 440 Volt

G.E. 62½ HP 1150 RPM 440/220 Volt

D. C. EQUIPMENT

Reliance Type A, V-8 Drive used six weeks 40 KW M-G set 50 HP 1750 RPM D.C. motor or 50 HP 200/600/1200 RPM D.C. motor

30—Clark Bulletin 5370 30 HP 230 Volt D.C. automatic starters—none used over two months.

A large number of adjustable speed D.C. motors from 5 to 150 HP

ALTERNATOR SPECIAL, Allis-Chalmers, 125 KVA 277 RPM 3 phase, 60 cycle.

The Electric Motor & Repair Co., Cuyahoga Falls, O.

1—400 HP Westinghouse, type CW, 3 ph. 60 cy, 440V, 450 RPM slip ring motor
1—250 HP General Electric, 3 ph, 60 cy, 440V, 1-17 400 RPM
1—200 HP Allis Chalmers, 3-60-440V, 514 RPM
1—150 HP Allis Chalmers, 3 ph, 60 cy, 440V, 450 RPM slip ring
1—150 HP Electric Mach. syn. motor, 125 KVA, 3-60-220V, 1200 RPM
1—150 HP General Electric, 3-60-440V frames 17A 360 RPM slip ring
1—150 HP Westinghouse, 2 ph, 60 cy, 440V frame 1000, CW. 390 RPM slip ring
4—100 HP General Electric, 3-60-440V, 495 RPM, MT 562 slip ring
2—100 HP General Electric type I, form K, 3-60-220V 575 RPM

50 KW Westinghouse, 125/250 V, type SK, frame 160, 3 wire generator direct connected to a 100 HP General Electric, type KT356, 900 RPM, 3 PH, 60 CY, 220 V motor on fabricated base.

1—100 HP Westinghouse, type CCL, 3 ph, 60 cy, 2200V, 1750 RPM, Squirrel Cage
1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy, 220V, 690 RPM slip ring
1—100 HP G. E., 3 ph, 60 cy, 440V, 580 RPM, type I-M slip ring
1—100 HP General Electric, 3 ph, 60 cy, 4000V, 720 RPM syn., type TS with direct connected exciter
2—100 HP Crocker Wheeler, size 2AQ, 3 ph, 60 cy, 440V, 385 RPM slip ring
1—100 HP Westinghouse, type CS, 3 ph, 60 cy, 440V, 1750 RPM sq. cage
2—75 HP 300 foot head Pumps: 2200V Fairbanks-Morse, 1800 RPM 3 ph, 60 cy, slip ring motors direct connected to 500 GPM 3 stage
1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V 450 RPM slip ring
1—75 HP Fairbanks-Morse, type H, frame 165C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage
1—75 HP Lincoln, type IQ, 2 ph, 60 cy, 440V, 600 RPM Squirrel Cage
1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 600 RPM slip ring
1—75 HP General Electric, 3 ph, 60 cy, 440V, 600 RPM, MT558 slip ring
1—75 HP Western Elec. type I, 3-60-440V, 690 RPM
2—75 HP Allis Chalmers, 3 ph, 60 cy, 440V, 860 RPM slip ring
1—60 HP Lincoln 3-60-220V frame IXM, Sq. Cage, 900 RPM
1—60 HP General Electric, 3-60-440V, 720 RPM, type I, form K
1—60 HP General Electric, 3-60-440V, 1750 RPM, type I slip ring
1—60 HP Westinghouse, 3 ph, 60 cy, 220V, 1160 RPM, type CS-644C
1—50 HP Wagner (Fynn Weichsel) 3-60-440V, 1200 RPM
1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring
1—50 HP Triumph 3-60-440V, type C12, 1150 RPM, slip ring, rotor & stator rewound
1—50 HP General Electric, 3-60-440V, KT-346, 870 RPM, Sq. Cage
1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring
1—50 HP Howell 3-60-440V, 870 RPM, type SCBB ball bearing Sq. Cage
1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage
2—50 HP Allis-Chalmers 3-60-440V, 690 RPM slip ring
1—50 HP General Electric 3-60-440V, 690 RPM, MTS 46, slip ring
1—50 HP Ideal 3-60-440V, 580 RPM, type AV, slip ring
3—50 HP General Electric 3-60-440V, 575 hPM, type I-K, fr. 13A, Sq. Cage
1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage
1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage
1—50 HP General Electric 3-60-440V, 490 RPM, type I-M, slip ring
1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage
1—50 HP Allis-Chalmers, 3 ph, 60 cy, 220V, 1160 RPM, type AR-220D
1—50 HP Howell, 3 ph, 60 cy, 440V, 1165 RPM, type SC50-4, ball bearing
1—50 HP Allis-Chalmers, 3 ph, 60 cy, 550V, 860 RPM sq. cage
1—50 HP General Electric, type I-M, 3 ph, 60 cy, 440V, 720 RPM slip ring
1—45 KVA Fairbanks Morse, 3 ph, 60 cy, 220V, 1200 RPM alternator.
2—30 HP Fairbanks-Morse, 3 ph, 60 cy, 220V, 3600 RPM, type HO, frame 12B ball bearing
1—30 HP, Wagner, 3 ph, 60 cy, 440V, 900 RPM, type 19TCM, totally enclosed fan cooled, ball bearing

We have a stock of 3000 motors from 1 HP to 50 HP in AC and DC. We have a very large stock of air circuit breakers up to 12000 amp.

2—175 HP, 230V, DC Westinghouse, type SK, 525 RPM
1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM
1—60 HP Westinghouse, type SK, frame 160, 230V, 880 RPM
1—60 HP Westinghouse, type SK140L, 115V, 1150 RPM vertical
1—50 HP Westinghouse, type SK, fr. 160, 230V, 565 RPM
1—50 HP Westinghouse SK200, 245 RPM, 230V
1—DC Generaor 45KW Bullock, 120V, 375A, 900 RPM
2—40 HP C & C 230V, 250/1000 (planer)
2—40 HP, G. E., 3 ph, 60 cy, 440V, 435 RPM, type 1-13A

25 CYCLE MOTORS

1—50 HP Westinghouse 3-25 cy-440V, 720 RPM, type MS, Sq. Cage
1—50 HP General Electric, 3-25 cy-440V, 700 RPM, type I-M, slip ring
1—40 HP Westinghouse 3-25 cy-440V, 730 RPM, type CI, frame 753A slip ring crane
1—35 HP Allis-Chalmers 3-25 cy-440V, 720 RPM, slip ring
1—30 HP Westinghouse 3-25 cy-440V, 720 RPM, CS. Sq. Cage

The Wente Electric Co.,

Hamilton, Ohio

REBUILT MOTORS & GENERATORS SINCE 1906

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Power Plant Equipment

BOILERS and STOKERS

2—2000 lbs. per hr. new Unifine coal pulverizers complete with burners, motors and starters—available immediately.
B. & W. Boilers 1-880 Cross Drum—6-500-750 H.P. with Stokers, 200# pressure
1—183 H.P. 150# Bigelow Boiler

10 Ton Handcrane and Runway Complete

1—8'x33' long Heavy Fuel Oil Service Tank
Number of steam pumps, duplex and single acting from 3 x 2 x 3 up to 20 x 12 x 15. Some of these are new.

TURBO GENERATORS from 500 to 15000 K.W.

Diamond Soot Blowers, 38 sets, 2" x 2½" valve in head
Transformers up to 5000 Kva.—3—2500 Kva, 9—300 Kva, 3—500 Kva. Number of smaller sizes.

Also have in stock oil circuit breakers up to 3,000 amps. and 74,000 volts—disconnect switches up to 6000 amps.

Stock of 5,000 current and potential transformers of all sizes, all kinds of relays, overload, underload, etc.

We also buy complete plants outright. What have you for sale?

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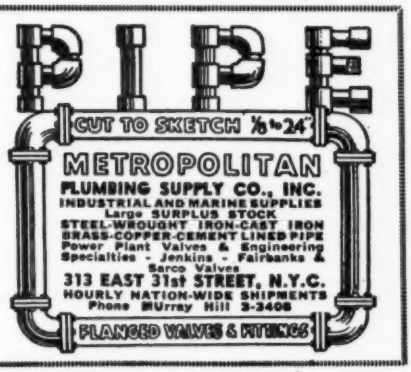

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Reconditioned Motors, Generators, Control Equipment, etc.
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TURBO-GENERATORS

A FEW OF THE COMPLETE UNITS NOW IN OUR STOCK

1—6000—KVA West. 3/60/2300V, 275#
1—3125—KVA GE 3/60/2300V, 200#
2—1875—KVA GE 3/60/2300V, 200#
1—1000—KW, DC, West. 3/60/250; 135/200#
2—937—KVA Allis-Chal. 3/60/2300:200#
1—250—KVA GE. Non-Cond. 3/60/480

Also Any Capacity or Type Desired.

WILMS, WEAVER & COMPANY

PENOBSCOT BLDG. DETROIT 26, MICHIGAN

SYNCH. CONVERTERS

500 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

300 KW RW SYN. 250V. 440/2300/4000 A.C. 720 RPM
200 KW. G.E. SYN. 250 V. 2300/4000 A.C. 1200 RPM
200 KW G.E. IND. 600 V. 2300/4000 A.C. 1200 RPM
200 KW RW SYN. 250 V. 2300/4000 A.C. 900 RPM

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MOTOR GENERATOR SETS
ROTARY CONVERTERS
SWITCHBOARDS BUILT TO ORDER

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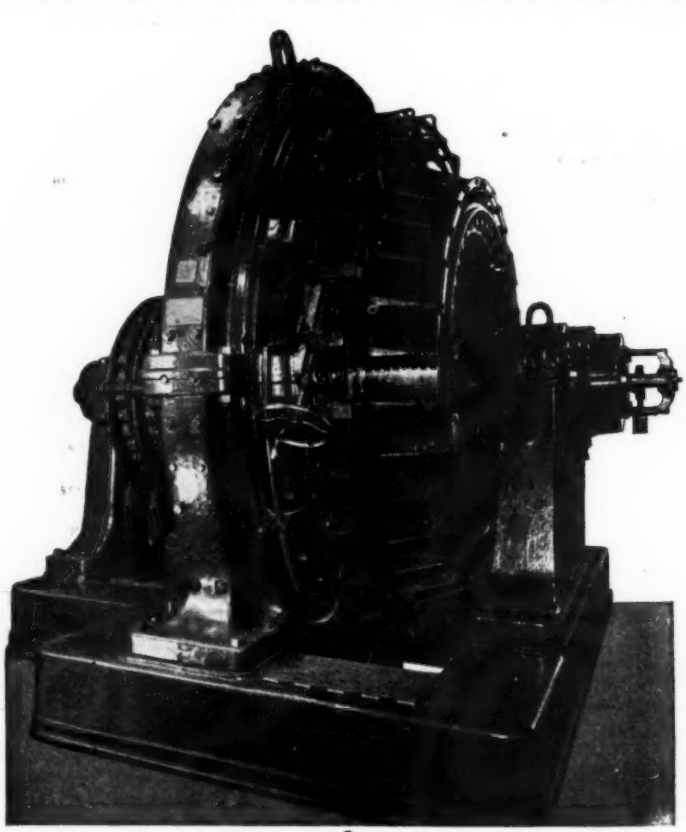
3500 KW ROTARY CONVERTER



Actual Photograph

3500 KW (2) WESTINGHOUSE interpole rotary converters, 225/285 volts D.C., 225 RPM; 6 phase 60 cycle A.C., with 3 phase 60 cycle 13200 volt transformers. Complete with control.

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SQUIRREL CAGE MOTORS

3 PHASE—60 CYCLE—220 OR 440 VOLTS

Qua.	H.P.	Mfr.	Type	Speed
1	300	Gen. Elec.	I-K	1800
1	250	G.E.	I-K	900
1	150	Gen. Elec.	I-K	1200
1	150	Gen. Elec	IK-15	900
1	150	Gen. Elec.	IK-16	600
1	150	Cr. Wheeler	126Q	600
1	100	Allis Ch.	AN	1800
2	100	Allis Ch.	AN	900
1	100	Gen. Elec.	IK-15	720
1	100	Allis Ch.	AN	600
1	75	Gen. Elec.	KT337	1800
2	75	Allis Ch.	AN	720
1	75	Whse.	CCL	720
1	75	Gen. Elec.	I-K	600
1	60	Gen. Elec.	I-K	600
1	50	Lincoln	DH412	1200
1	50	Gen. Elec.	KT342	900
2	50	Whse.	CCL	900
1	50	Allis Ch.	AN	514
1	40	Gen. Elec.	I-K	1200
3	40	Fair Morse b.b.	H12C	900
2	40	Allis Ch.	AR420	900
6	30	Allis Ch.	AN	1200
2	30	Gen. Elec.	KT326	1200
2	30	Gen. Elec.	KT332	900
1	30	Allis Ch. b.b.	AR220	900
2	30	Allis Ch.	AN	600
2	25	Fair. Morse b.b.	H10C	3600
1	25	Gen. Elec.	KT312	1800
3	25	Gen. Elec.	KT322	1200
1	25	G.E. tot. encl.	KT536	1200
2	25	Gen. Elec.	KT326	900
2	25	Allis Ch.	AN	600

SLIP RING MOTORS

3 PHASE—60 CYCLE—220 OR 440 VOLTS

Qua.	H.P.	Mfr.	Type	Speed
1	500	Allis Ch. 2200 v.	ANY	514
1	400	G.E. 2200 v.	I-P	1200
1	300	G.E. 3 brg.	I-P	450
1	300	Burke	EMV	225
1	200	Whse.	CW	600
1	200	Cr. Wh. 3 brg.	SR26Q	720
1	150	G.E. 2200 v.	I-E13AA	1800
2	150	Triumph	SR	514
1	100	G.E. 2200 v.	I-E13A	1800
1	100	Whse.	CW	900

SLIP RING MOTORS—Cont.

1	100	G.E. 2200 v.	IM-15	720
1	100	Gen. Elec.	I-M	600
1	75	Ideal 2200 v.	D120	1800
1	75	G.E. 2200 v.	I-E13	1800
1	75	Cr. Wheeler	SR22Q	900
1	75	Allis Ch.	ANY	600
1	75	Gen. Elec.	MT558	600
2	60	Whse. 2200 v.	CW657	1800
5	60	Gen. Elec.	M-505	1200
1	50	Gen. Elec.	MT536	1200
1	50	Allis Ch.	ARY	900
1	50	Al. Ch. b.b. 2200 v.	ARY	900
1	50	Allis Ch.	ANY	720
2	50	Whse.	HF13A	600
1	40	Northw'n.	HW35A	1200
6	40	Gen. Elec.	MT532	1200
2	40	G.E. 2200 v.	MT332	1200
1	40	Wagner	22WBR	900
1	40	G.E. 3 brg.	I-M	600
1	35	F. Morse b.b.	HV-12B	1800
2	35	Gen. Elec.	I-M	900
2	30	Northw'n. b.b.	HW404	1800
2	30	Allis Ch.	ANY	900
1	25	Northw'n. b.b.	HW404	1800
1	25	Howell	SR	1800
1	25	Gen. Elec.	I-M	1200
1	25	Allis Ch. b.b.	ARY	900

SYNCHRONOUS MOTORS

H.P.	Mfr.	Type	Volts	Speed
300	Whse.	ped.	220/440	900
250	G.E. 1 brg.	ATI	220/440	600
165	G.E. 3 brg.	TRB	220/440	450
100	Allis Ch.	.8PF	220/440	600

60 CYCLE A. C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
300	Whse.	ped.	240/480	900
250	Gen. Elec.	ATB	240/480	600
200	Gen. Elec.	TRB	240/480	720
150	Elec. Machy.		240/480	900
125	Whse.	ped.	2300	600
100	Cr. Wheeler		240/480	600
50	Gen. Elec.	ATB	240/480	1200

HIGH FREQUENCY GENERATORS
2—300 KVA Crocker Wheeler 3 phase 180 cycles, 250 volts, 1800 RPM on base

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	G	250	1200
75	Whse.	ped.	125	750
55	Bullock	ped.	250	900
50	Northern	B	125	650
35	Fair. Morse	TRC	250	1200
25	Gen. Elec.	DLC	125	900
16	Cr. Wheeler	CCD	125	415

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
250	Gen. Elec.	G	250	1200/1500
100	G.E. series	CO	230	570
75	Whse.	SK	230	600
50	National	CS	230	800
50	Northern	B	115	500/1000
35	Northw'n.	B	115	1000
30	Lincoln	FP	230	1750
30	Bogue	interpole	230	700
25	Gen. Elec.	RC10	500	1500
25	Gen. Elec.	LC	230	1700
25	Roth	elevator	230	735
20	Whse.	SK83	230	1750
20	Gen. Elec.	RC30	230	1150

AIR COMPRESSOR
12x6x10—2 stage Chicago Pneumatic type OCB, 300 cfm, 200 lbs., fine condition

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250 KW Burke comp. interpole gen. DC 125V, coupled to 375 HP Burke synch. motor 3-60-220/440 V.—900 RPM.
100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125V. coupled to 150 HP I-K sq. cage motor 3-60-2300/4000 V.—1200 RPM.
75 KW Allis Ch. 2 brg. unit gen. DC 120 V. comp. wd. coupled to 112 HP s. c. motor 25 cycle 220/440 V.—750 RPM.
35 KW Fair Morse TRC gen. DC 250 V. coupled to 50 HP b. b. sq. cage motor 3-60-220/440 V.

CENTRIFUGAL PUMP
8" Cameron 1500 gpm @ 250 ft. head, on base coupled to 150 HP G.E. motor 3-60-2200-v.-1800 RPM

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2—500 KW WEMCO. 240/300 V, 375 RPM, 3/25/13,200 v.
2—2500 KW WEMCO. 245/310 V, 450 RPM, 3/60/13,200 v.

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1—6875 KVA WEMCO. 13,200/4150 v. 25/62½ cy., 375 RPM
1—2000 KVA WEMCO. 13,200/4150 v. 25/62½ cy., 375 RPM

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1—1000 KW M-G set, WEMCO. 230/275 v., 295 RPM, 3/60/4400 v.

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2 Lecourtenay 5" all bronze centrifugal pumps 500 GPM at 90' head direct connected to Allis Chalmers 20 HP Motor 440, 60, 3, 1740 RPM.

2 Lecourtenay 12" Iron Casing Motor Driven Centrifugal Pumps, type 12BT8, 5,000 GPM at 148' H., Direct connected to G.E. 250 HP Motor, type 1, E15 form K, 440, 60, 3, 1760 RPM.

Lecourtenay 12" Iron Casing Motor Driven Centrifugal Pump, 4,500 GPM at 135' H. 1750 RPM Direct Connected to Allis Chalmers 200 HP Motor 440, 60, 3, 1750 RPM.

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Terry Steam driven Turbine centrifugal pump, type GF, turbine 710 HP, 145# steam pressure, 60# backpressure, 3581 RPM direct connected to Gear Unit 1000 RPM; type U Allis Chalmers Centrifugal Pump 18" x 18", 13,000 GPM at 170' head, 1000 RPM. Pump or turbine may be bought separately.

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440 volt—3 phase—60 cycle

2—20 HP Allis Chalmers,1740 RPM

2—10 HP Gen. Elec., 1200 RPM

2—25 HP Allis Chalmers, 860 RPM

1½ HP Gen. Elec., 220/440 volt, 1720 RPM with G. & F. Speed reducer Worm Gear type ratio 10.20 to 1

1½ HP Gen. Elec., 220/440, 1720 RPM

7½ HP (Motor) Allis Chalmers, 1150 RPM

5 HP Allis Chalmers, 860 RPM

15 HP Gen. Elec., Type KT, 900 RPM with De Laval Worm Gear Reduction Unit 12¾ HP Ratio 13⅓ to 1.

15 HP Gen. Elec., Type KT, 900 RPM

10 HP Gen. Elec., 1200 RPM

10 HP Gen. Elec., Type KT, 1200 RPM

250 HP Gen. Elec., Type 1, Form K, 1760 RPM

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SPEED REDUCERS

G. & F. Speed reducer, Worm Gear type, ratio 10.20 to 1.

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75 HP Westinghouse 440, 60, 3, 840, direct connected to Westinghouse

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1800 HP. 550' Head.
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2—CENT. PUMPS 4166 GPM. 162' Head
1—3600 GPM, 27' head CENT. PUMPS
TRAVELING CRANE, 75 ton Case, 64' Span, 3 Motors. Also others.
750 KW. and 110 KW. AC HYDRO ELEC.
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25 HP Bissell Induction Motor—Serial No. Z-17255—2 Ph.—60 Cy. 440 Volts—32 Amp.—900 RPM. This motor has new winding.

1 HP Howell Red Band Induction Motor—Type SC—Frame 0006—3 Ph. 60 Cy., 550 Volts—1.3 Amp. Serial No. 29181—1800 RPM.

25 HP Lincoln Induction Motor—Serial No. 50849—List No. 12228—Frame C-14—3 Ph.—60 Cy. 440 Volts—32 Amp.—35° Temp. rise 900 RPM—Rails and gear.

1 150 HP Westinghouse Motor—500 RPM—60 Cy.—3 Ph.—440 Volts, Serial No. 4595978—Style 7.23655—Frame 954A.

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1—250 KVA Fairbanks-Morse Generator
1—300 HP YO Fairbanks-Morse Engine
1—100 HP YO Fairbanks-Morse with 75 Kva Gen.
1—210 HP Model 32 F & M Full Diesel with 150 Kva. V Belted Gen.—Boards—Air Starting Etc.
1—380 HP Anderson Full Diesel with 250 KW G.E. Generator—Board Etc.
1—180 HP Bessemer Oil Engine
2—250 HP Foos Nat. Gas Engines direct connected to 219 Kva Generator.
2—175 HP 6 Cylinder Foos Gas Engines, 720 RPM. with or without Generator Bessemer Gas Engine 60 HP to 150 HP
1—62½ KW Bal. valve Steam Engine
1—100 KW Erie Ball 4 Valve Steam Generating Unit
1—250 Kva Murray Corless Generating Unit
3—500 KW Steam Turbines

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One Type L, 3-cylinder, 4 cycle, 80 H.P., 720 R.P.M. Foos Full-Diesel Engine, direct-connected to a 2300 volt General Electric Alternating Current Generator and Exciter. This engine is in good condition and has been used very little; may be seen at Floridale Hotel site, 13 miles east of Milton, Florida on U. S. Highway No. 90. For further particulars, address: Frank D. Quinn, Owner, 106 East 13th Street, Austin 11, Texas or J. E. Cox, Custodian, Harold, Florida.

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2— 25 H.P. Price $95.00 ea.
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Westinghouse, and General Electric, all 60 cycle, 3 phase, 2200 volt with overload coils.

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625 KVA—Genl. Elect. Generator—3/60/480 Volts—Direct connected to 24x42 Simple Corliss Engine—100 RPM. In A#1 Condition—Immediate Shipment.

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L. J. LAND AND COMPANY

D. C. Motors & Generators

Partial List Only!

230 VOLT DC MOTORS

H.P.	Make	Speed
300	G.E.	1100
150	West.	600
60	El. Dynam.	900
60	Roth	600
60	G.E.	480/1100 (2)
50	West.	550/1100
50	Cr. Wh.	700 (2)
50	G.E.	850
45	Diehl	850/1020
40	El. Dy.	1200
40	Reliance	400/1500
40	Cr. Wh.	915
35	West.	1150
25	Diehl	850/1020
25	G.E.	1150
25	G.E.	575
20	Cr. Wh.	1750
20	R & M	1160
20	G.E.	1150 (4)
20	West.	1150
20	G.E.	800 (2)
15	West.	1250
15	G.E.	1150 (3)
15	Cr. Wh.	900/1800
15	West.	850
10	West.	850 (2)
10	G.E.	825 (3)
10	G.E.	700
10	Al. Ch.	600/1800
10	West.	600/1200
10	G.E.	400/1600
10	West.	400/1200 (2)
9	G.E.	450/1800
8½	Diehl	900
8½	West.	850
8½	West.	350/1400
7½	Sturt.	3600
7½	Peerl's	1700
7½	West.	1450
7½	West.	1150 (2)
7½	G.E.	1150
7½	West.	975
7½	Al. Ch.	850
7½	El. Dy.	550/1650
7½	Watson	525/1150
7½	G.E.	400/1600
7½	West.	400/1600
7½	Al. Ch.	350/1050
7½	G.E.	300/1200
6	G.E.	400/1200
6	G.E.	450/1800 (2)
5½	West.	500/1500 (2)
5	West.	850
5	G.E.	900 (2)
5½	G.E.	400/1600
5	West.	1800
5	G.E.	1700
5	G.E.	1150 (2)
5	West.	1100
5	Al. Ch.	1150
5	Cont.	600/1800
5	West.	850
5	G.E.	850
5	Star	600/1200
5	El. Dy.	550/1650
5	G.E.	450/800
5	G.E.	600
5	G.E.	450/1350

230 VOLT DC MOTORS—Continued

5	West	400/1200
5	El. Dy.	275/1100
4	G.E.	850/1150
3½	West.	850/1600
3	West.	1700
3	West.	1150 (6)
3	Roth	500/2000
3	G.E.	500/1500
2½	West.	480/1800

236 additional 230 volt D. C. Motors in stock as small as 1/20 H.P.

115 VOLT DC MOTORS

H.P.	Make	Speed
90	G.E.	900
20	West.	200/900
12	West.	1100
15	Cr. Wh.	800
10	L. Allis	3500
10	West.	850
10	El. Dy.	425/1275
7½	G.E.	850 (2)
6	Burke	650
5	Cr. Wh.	1875
5	West.	1100 (2)
5	Cr. Wh.	960

75 additional 110 volt Motors down to 1/6 H.P.

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Reliance A.C. 10:1 Variable Speed Motor Drive
60 H.P. 3 ph. 60 cy. 220/440 volt A.C. Motor with 40 Kw 250 volt D.C. Generator Motor
40 H.P. 250 volt D.C. 150/1500 RPM. Push Button. Remote Control Equipment

BELTED AND MOTOR DRIVEN DC GENERATORS

200 KW	G.E.	250 volts
100 KW	West.	250 volts
96 KW	G.E.	60 volts
80 KW	El. Dy	250 volts
75 KW	West.	250 volts
60 KW	G.E.	600 volts
50 KW	West.	125 volts
48 K	West.	30 and 60 volts
45 KW	West.	250 volts
40 KW	Reliance	250 volts
30 KW	El. Dy.	600 volts
30 KW	G.E.	60 volts
40 KW	Cr. Wh.	125 volts
30 KW	West.	125 volts
25 KW	West.	125 volts
25 KW	G.E.	250 volts
20 KW	G.E.	125 volts
15 KW	West.	125 volts

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3—30-40 & 50 KW Gen. Motors 3/60/208 V.
100 H.P. Fairbanks Morse VA Engine.
100 H.P. Wolverine 3/60/480 V.
120 H.P. Muncie 125 V.—D.C.
120 H.P. DeLavergne, 3/60/220 V.
180 H.P. Fairbanks Morse 32E12 Engine.
200 H.P. McIntosh, 3/60/240 V.
250 H.P. Busch Sulzer 4B60 Engine.
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Birch Valves for all types of of reciprocating pumps.

LARGE GATE VALVES

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1—20" **Crane** 125# Flanged Hand Wheel operating Gate Valve.

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(with or without generators)

H.P.	Make	Cyl. Size	Flywheel	K.V.A
750	Corliss	32x42	20'	
600	Corliss	24x36	17'	
600	Robb-Armstrong	21x39x24		500
	Robb-Armstrong	21x36x24		360
275	Twin City	18x42	14'	220
250	McEwen	12x16	6'	200
	Robb-Armstrong	12x18x14	6'	120
	Robb-Armstrong	11x17/14	6'	100

DIESELS

Make	H.P.	R.P.M.	K.V.A.
2—Campbell	675	225	526
2—Dominion Crossley	400	514	375
1—Kromhout	350	240	250
1—Electric Boat	550	225	
1—Polar Atlas	120	275	100
1—FM CO 2	100	450	75

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450	600 ft.	
665	500 ft.	450

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100—5000 KW

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KVA	Volts	Cycle	Phase	dc	RPM
435	4000	60	3	600	870
435	4000	60	3	600	870
180	2200	60	2	125	580
436	13200	60	3	600	720
550	13000	60	3	600	720
					375
1500	12200	25	3	275	438
1500	12000	25	3	275	485
1287	12000	25 to 60 cycle			

Synchronous Motors or Condenser

125	2200	60	3	110	245
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500	2300	60	3	20 pole 360	
5000	13200	25	3		300

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1—2000 CFM Nordberg Compressor
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5—25 KVA General Elec. 220/127 Volts 3 ph. Type ATI. 80% P.F. 1200 RPM Revolving Field with Exciter.
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1—214 HP Erie City, str. tube, 200#
5—150 HP HRT, stokers, 150#
1— 37 HP Vulcan Locomotive, 190#
1—46.8 HP Un. Iron Wks. Loco., 200
1— 66 HP Vulcan Iron Wks, 200#
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Garfield, N. J.

2—Packard Elect. transformers 150 KVA 60 cycle type A 2400 volts to 115/230 volt temp. 55°.

1—Burdett Rowntree automatic dummy elevator 3 HP 220/3/60 1050 RPM. Elevator with rails, enclosure doors and cage.

FS-634, Power
520 No. Michigan Ave., Chicago 11, Ill.

L. J. LAND AND COMPANY

A. C. Motors & Generators

Partial List Only!

3 PHASE SQUIRREL CAGE MOTORS

H.P	Make	Speed
200	G.E.	600
150	G.E.	860
147	West.	715
100	G.E	1200
100	West.	720
100	G.E. (BTA)	375 750
75	West.	870
50	West.	1200
50	G.E.	900
50	Al. Ch.	690
40	G.E.	900
35	Wagner	850
30	U. S.	3450 Vert.
30	West.	1750 Vert.
30	Al. Ch.	514
25	Wagner	1200
25	West.	1140
25	Diehl	865 (3)
25	G.E.	900
25	Wagner	720
20	G.E.	1750 (3)
20	G.E.	1200 (2)
20	Cr. Wh.	1200 (2)
20	Al. Ch.	900 (2)
20	Diehl	900 (3)
20	G.E.	720
20	West.	1720
15	Cr. Wh.	1700
15	G.E.	1200 (3)
15	Wagner	720
15	G.E.	600
10	G.E.	720 (5)
10	G.E.	3450
10	West.	1150

325 additional three phase Motors down to ¼ H.P.

TWO PHASE SQUIRREL CAGE MOTORS

H.P.	Make	Speed
75	Cr. Wh.	870
50	Linc.	900
50	G.E.	900
40	G.E.	900
40	Al. Ch.	900
35	Al. Ch.	900
30	West.	1200
25	G.E.	1200
20	West.	1150
15	G.E.	1200
15	F & M	900
10	G.E.	1200
10	G.E.	900
7½	G.E.	900
7½	G.E. (BQS)	600 1350
5	G.E.	900
5	Al. Ch.	1200

146 additional two phase Motors down to ¼ H.P.

2 & 3 PHASE SLIP RING

H.P.	Make	Speed
250	G.E.	600
200	West.	580
200	G.E.	495
125	West.	1175
125	Burke	580
112	G.E.	900
100	F. M.	690
75	West.	1170
75	Al. Ch.	575
64	G.E.	585
60	West.	1135
60	West.	290
50	Ideal Vert.	1740
50	G.E.	870 (2)
50	West.	850
40	Wagner	1150
40	F. M.	870 (2)
40	West.	870
40	Linc.	690
30	G.E.	870
30	G.E.	690
15/35	West.	6/1200 (5)
25/55	G.E.	6/1200
20/50	West.	6/1200
25	Al. Ch.	870 (2)
25	West.	850
25	G.E.	870 (2)
25	G.E.	720
25	West.	575
20	G.E.	870
20	West.	575

116 additional Slip Ring Motors in stock down to ⅓ H.P.

40 H. P.

Reliance A.C. 10:1 Variable Speed Motor Drive
60 H.P. 3 ph. 60 cy. 220/440 volt A.C. Motor with 40 Kw 250 volt D.C. Generator Motor
40 H.P. 250 volt D.C. 150/1500 RPM. Push Button. Remote Control Equipment

SINGLE PHASE MOTORS

H.P.	Make	Speed
20	Wagner	1160
20	Cent.	1165
7½	Cent.	3500

38 additional single phase Motors.

AC GENERATORS

200 KW G.E.	600
150 KW G.E.	720
100 KW G.E.	600
100 KVA West.	600
75 KVA West.	900
25 KVA West.	1800

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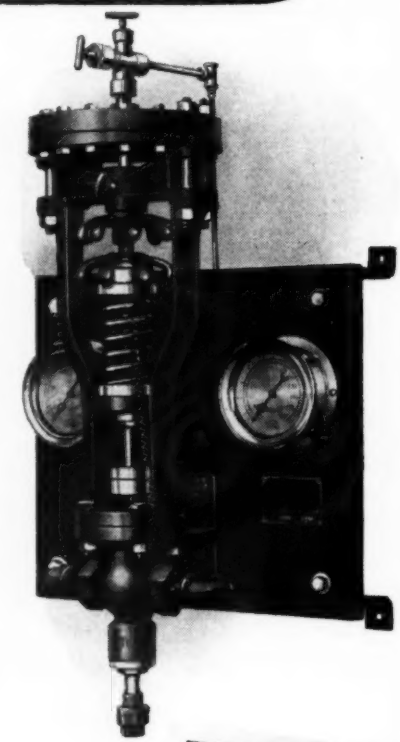
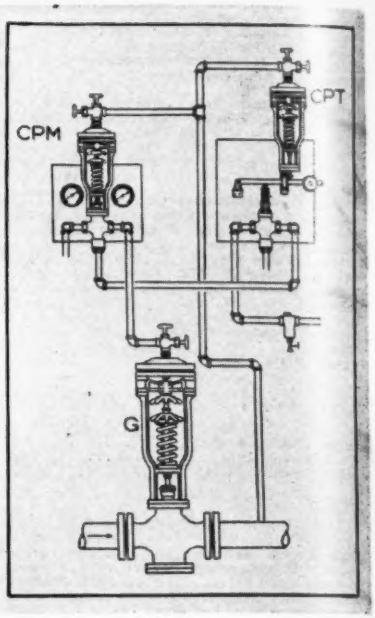
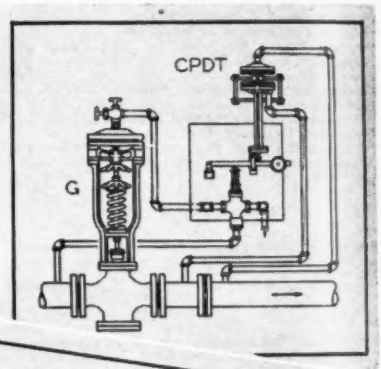
It pays you to learn

how you can avoid the risk of shutdowns, costly repairs and loss of time with

Swartwout Master Controls



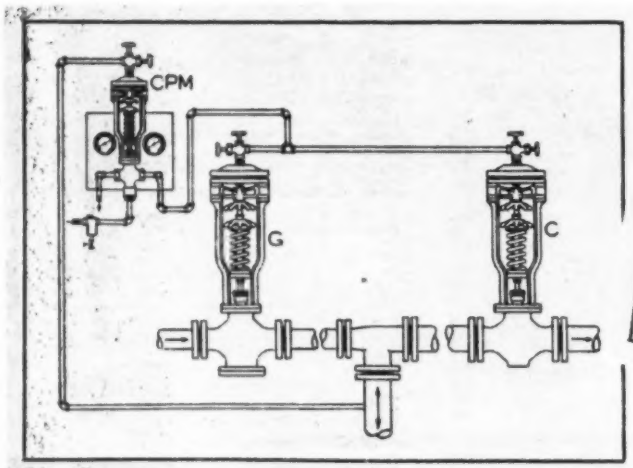


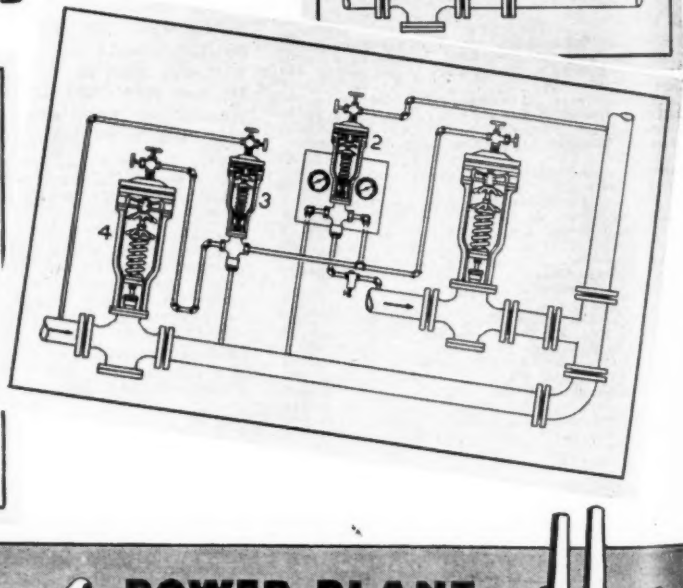


THESE condensed hookup diagrams give you but a small sample of many Swartwout Master Control applications that can help you handle pressures and temperatures of almost any range.

Highly developed, yet simple mechanisms, Swartwout Masters lift the anxiety of watching dangerous pressures—solve problems of constant pressure and variable pressure control, combination relief and make-up service, differential pressure control and combination requirements of every description.

Simple design, rugged construction, easy adjustment features make these quick-acting devices safe and dependable. Send for Bulletins S-22-B and S-100-H (list of users) or ask your consulting engineer to look into the possibilities of applying Swartwout Masters to your control requirements.

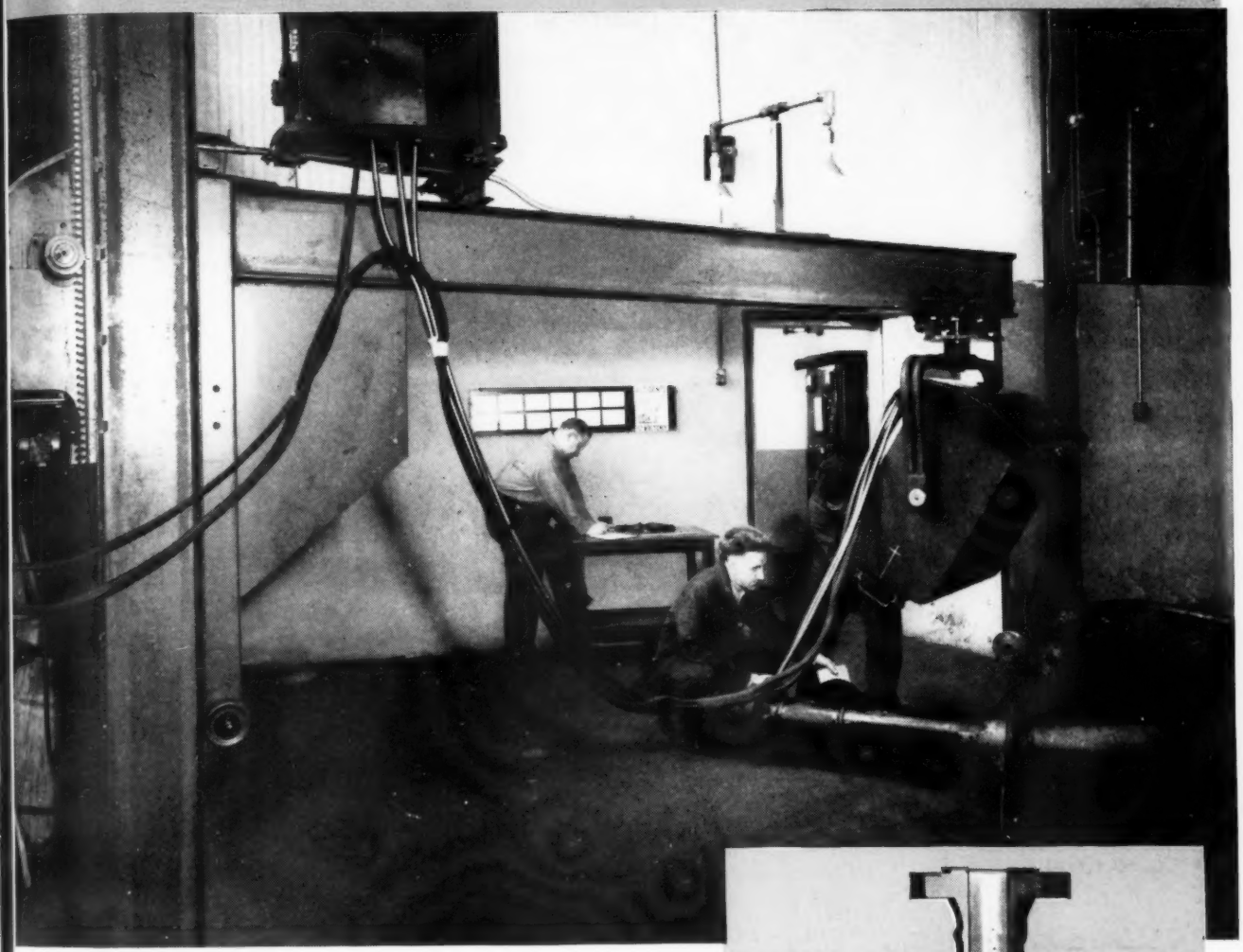


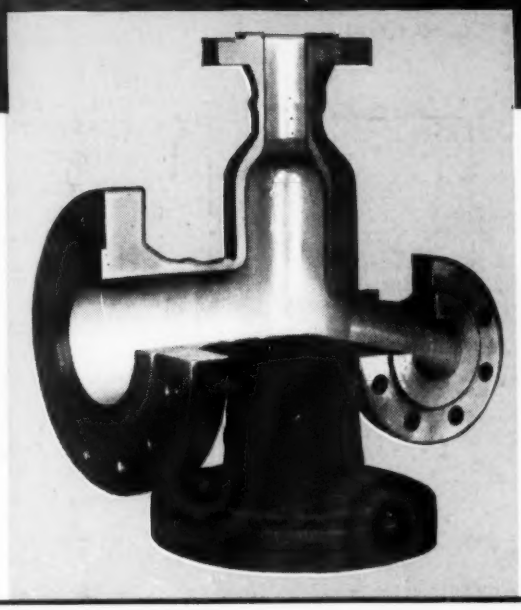


Swartwout POWER PLANT EQUIPMENT

THE SWARTWOUT COMPANY • 18511 Euclid Ave., Cleveland 12, Ohio

There's no Hiding Place





ANY welding imperfection in piping shows up immediately under the X-ray and gamma ray inspection methods used by Grinnell. This is especially important in FLUID TRANSPORT today, for in many fields the trend is toward higher pressures and higher temperatures . . . and consequent increasingly rigid specifications. For instance, the excellent operating records of the high-pressure piping lines of the Navy's Destroyer Escort vessels is due in no small measure to the type of radiographic inspection used by Grinnell.

The test equipment required for X-ray inspection makes shop fabrication of sub-assemblies essential. As fabricator and manufacturer Grinnell supplies the many pretested component parts for any type of piping system.

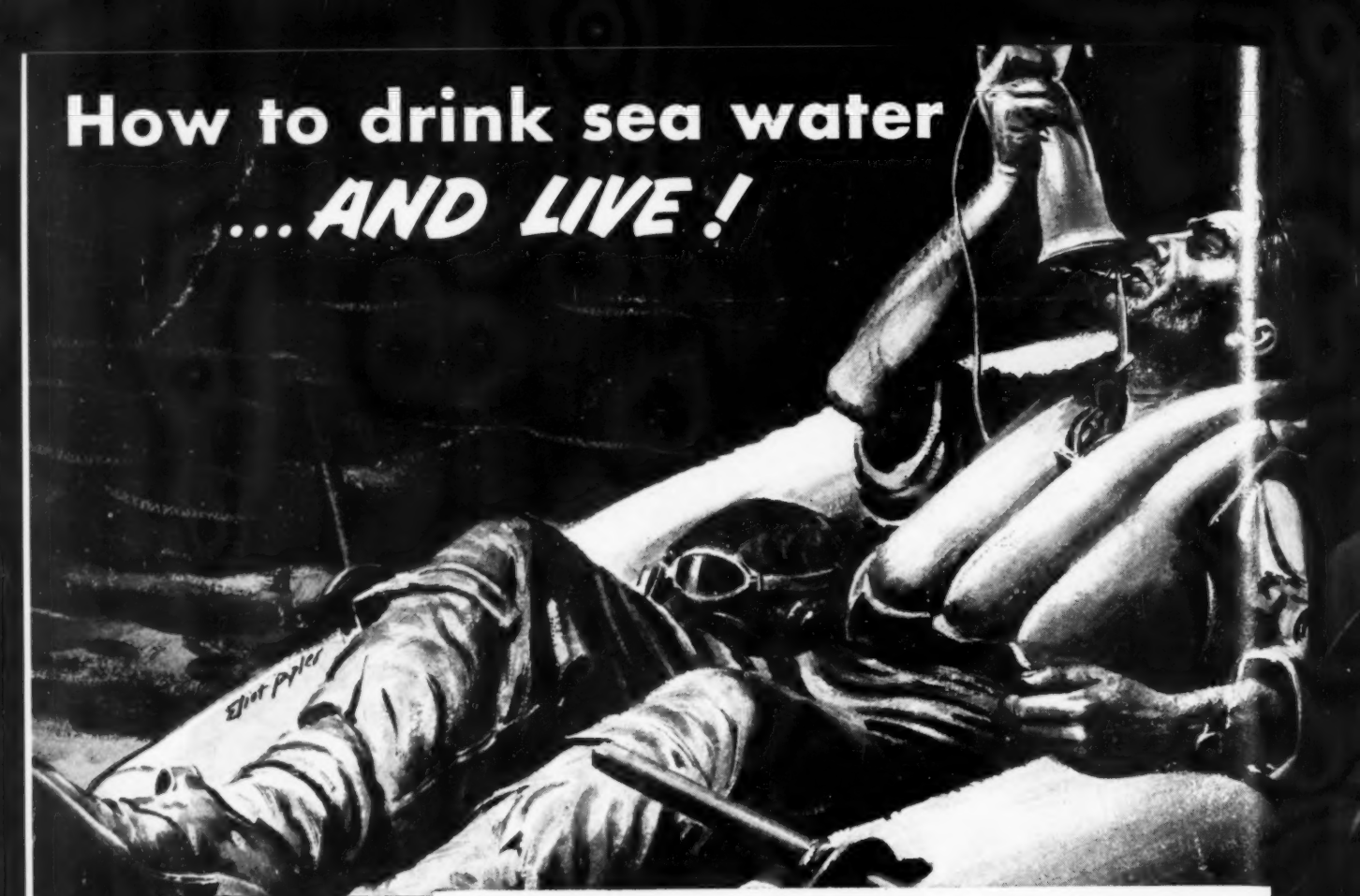
GRINNELL

WHENEVER **PIPING** IS INVOLVED

For engineering assistance on any phase of FLUID TRANSPORT, call Grinnell Company, Inc., Executive Offices, Providence 1, R. I. Plants and offices throughout U. S. and Canada.

Pipe Fabrication Facilities: Providence R. I. - Warren, Ohio - Atlanta, Ga.

How to drink sea water ...AND LIVE!



FORCED down at sea, this pilot will live to fly and fight again, because thirst—age-old enemy of shipwrecked men—has been conquered. Now he can drink sea water!

Packed with his deflated life-raft, the flyer carries a compact Permutit Sea-water Desalting Kit. Adrift, he simply scoops up sea water in a plastic bag, drops in a small briquet and in a few minutes the water—fresh and clear—is ready to drink. The briquet precipitates the dissolved salts, which are then filtered out as the flyer sucks the water through a tube. Each briquet in his supply will freshen enough water to keep him alive for a day. The whole operation is so simple that it can easily be carried out by a man on a life-raft.

The problem of developing a practical de-salting method was early recognized by Permutit. Here at water conditioning headquarters, chemical engineers worked intensively on it for months and the final product was acceptable to the U.S. Navy, Army and Air Transport Command. The successful result adds one more field to the many in which Permutit's long experience in water treatment is serving our country at war. The Permutit Company, Dept. A, 330 West 42nd St., New York 18, N. Y. In Canada: Permutit Company of Canada, Ltd., Montreal.

The Permutit Sea-water Desalting Kit occupies only one-tenth the space of the drinking water it produces.

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